FAIRCHILD SEMICONDUCTOR

April 2001

IGBT

SGS6N60UFD

Ultra-Fast IGBT

General Description

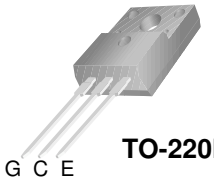
Fairchild's UFD series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UFD series is designed for applications such as motor control and general inverters where high speed switching is a required feature..

Features

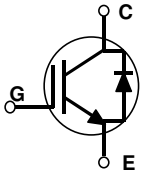
- High speed switching
- Low saturation voltage : $V_{CE(sat)}$ = 2.1 V @ I_C = 3A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 35ns (typ.)

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		SGS6N60UFD	Units
V_{CES}	Collector-Emitter Voltage		600	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Collector Current	@ T_C = 25°C	6	A
	Collector Current	@ T_C = 100°C	3	A
$I_{CM\ (1)}$	Pulsed Collector Current		25	A
I_F	Diode Continuous Forward Current	@ T_C = 100°C	4	A
I_{FM}	Diode Maximum Forward Current		25	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	22	W
	Maximum Power Dissipation	@ T_C = 100°C	9	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	--	5.5	°C/W
$R_{\theta JC}$(DIODE)	Thermal Resistance, Junction-to-Case	--	8.0	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

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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 = 3mA, V_{CE} = V_{GE}	3.5	4.5	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 3A, V_{GE} = 15V	--	2.1	2.6	V
		I_C = 6A, V_{GE} = 15V	--	2.6	--	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30V, V_{GE} = 0V, f = 1MHz	--	220	--	pF
C_{oes}	Output Capacitance		--	22	--	pF
C_{res}	Reverse Transfer Capacitance		--	7	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 3A, R_G = 80Ω, V_{GE} = 15V, Inductive Load, T_C = 25°C	--	15	--	ns
t_r	Rise Time		--	25	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	60	130	ns
t_f	Fall Time		--	70	150	ns
E_{on}	Turn-On Switching Loss		--	57	--	μJ
E_{off}	Turn-Off Switching Loss		--	25	--	μJ
E_{ts}	Total Switching Loss		--	82	120	μJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 3A, R_G = 80Ω, V_{GE} = 15V, Inductive Load, T_C = 125°C	--	22	--	ns
t_r	Rise Time		--	32	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	80	200	ns
t_f	Fall Time		--	122	300	ns
E_{on}	Turn- On Switching Loss		--	65	--	μJ
E_{off}	Turn- Off Switching Loss		--	46	--	μJ
E_{ts}	Total Switching Loss		--	111	170	μJ
Q_g	Total Gate Charge	V_{CE} = 300 V, I_C = 3A, V_{GE} = 15V	--	15	22	nC
Q_{ge}	Gate-Emitter Charge		--	5	8	nC
Q_{gc}	Gate-Collector Charge		--	4	6	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 = 4A	T_C = 25°C	--	1.4	1.7	V
			T_C = 100°C	--	1.3	--	
t_{rr}	Diode Reverse Recovery Time	I_F = 4A, di/dt = 200A/μs	T_C = 25°C	--	35	52	ns
			T_C = 100°C	--	53	--	
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	--	60	135	nC
			T_C = 100°C	--	120	--	

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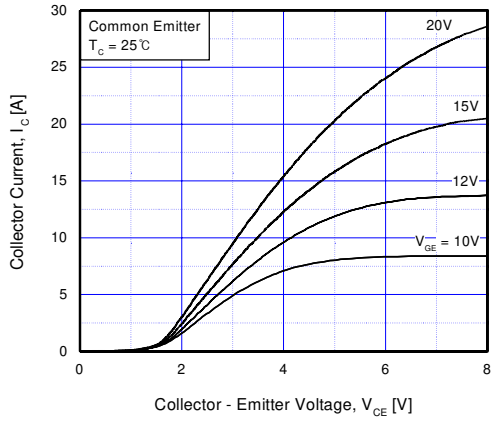

Fig 1. Typical Output Chacracteristics

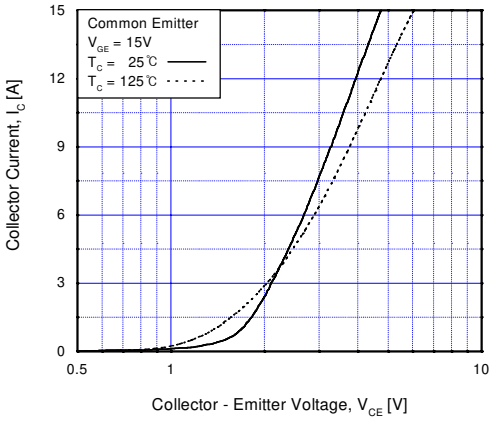

Fig 2. Typical Saturation Voltage Characteristics

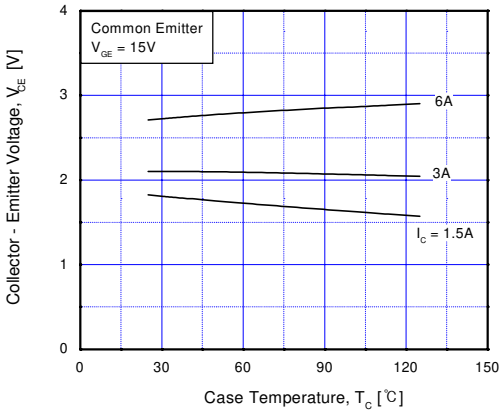

Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

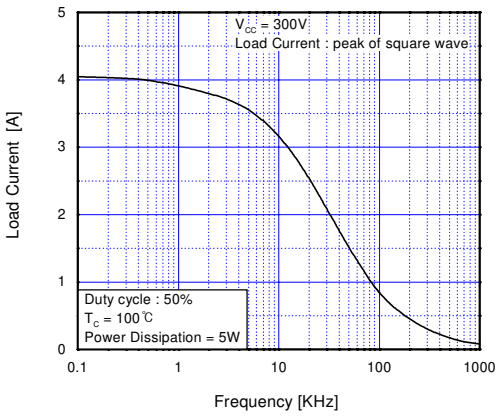

Fig 4. Load Current vs. Frequency

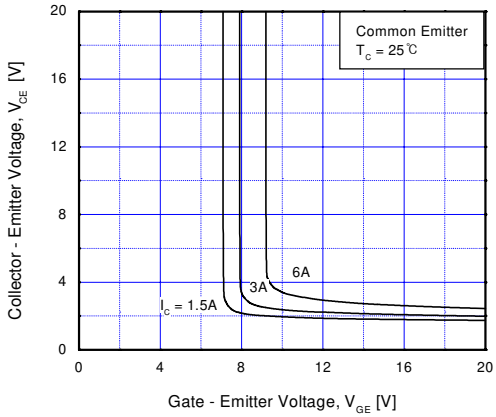

Fig 5. Saturation Voltage vs. V_{GE}

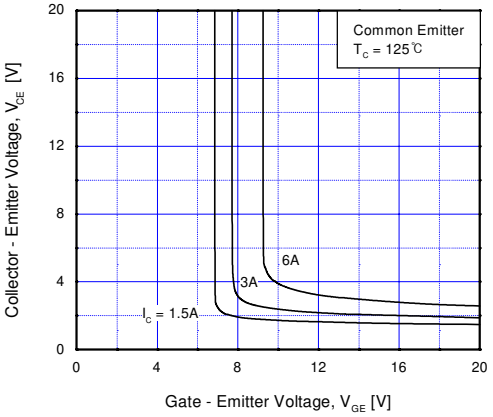

Fig 6. Saturation Voltage vs. V_{GE}

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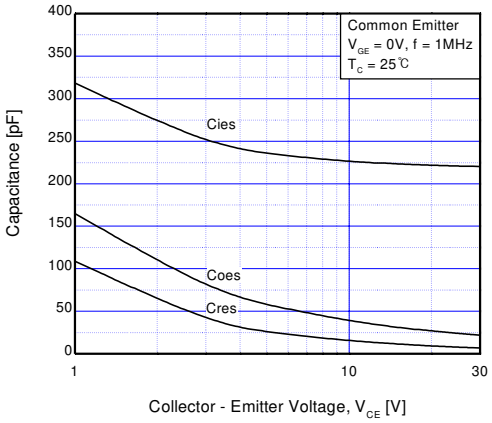

Fig 7. Capacitance Characteristics

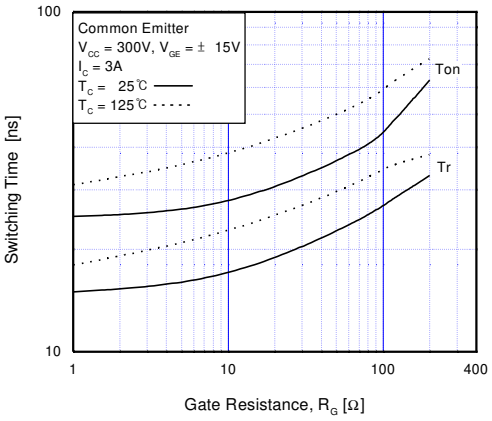

Fig 8. Turn-On Characteristics vs. Gate Resistance

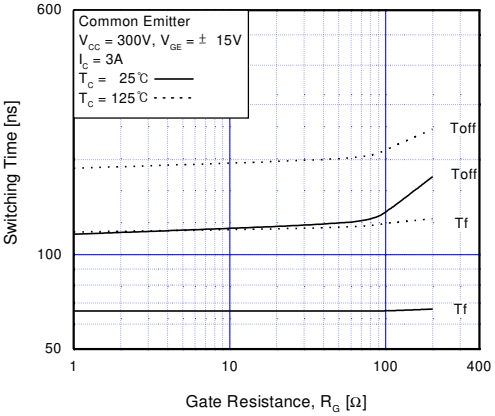

Fig 9. Turn-Off Characteristics vs. Gate Resistance

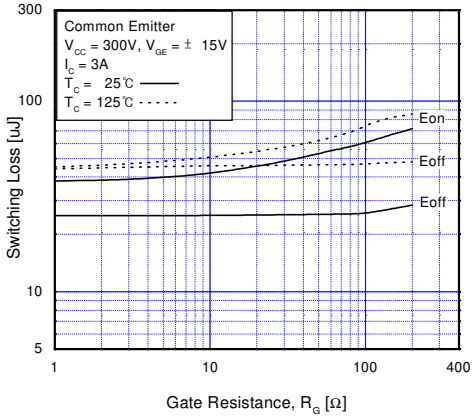

Fig 10. Switching Loss vs. Gate Resistance

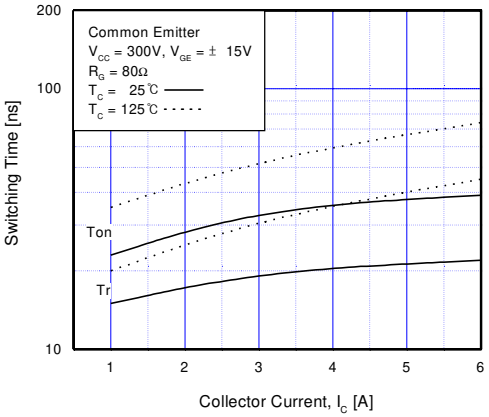

Fig 11. Turn-On Characteristics vs. Collector Current

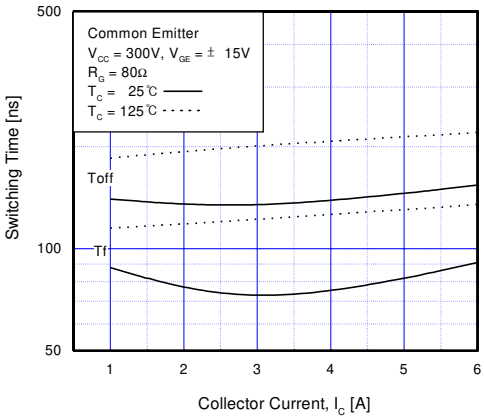

Fig 12. Turn-Off Characteristics vs. Collector Current

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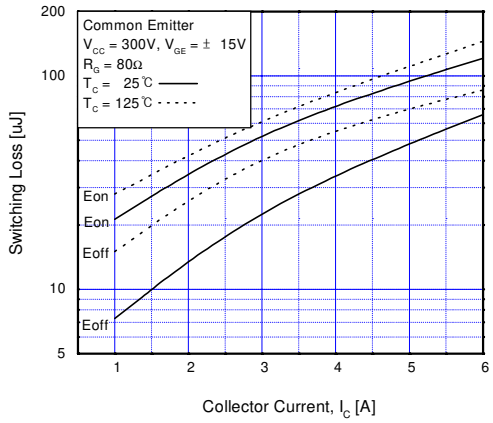

Fig 13. Switching Loss vs. Collector Current

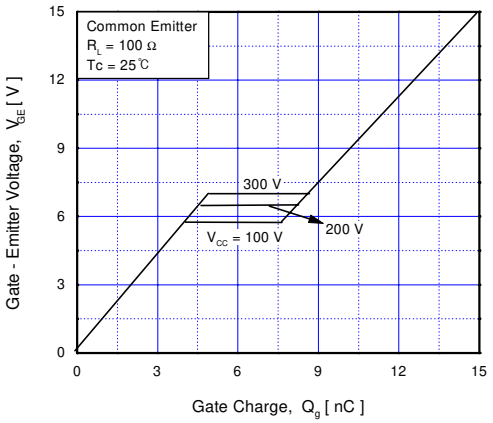

Fig 14. Gate Charge Characteristics

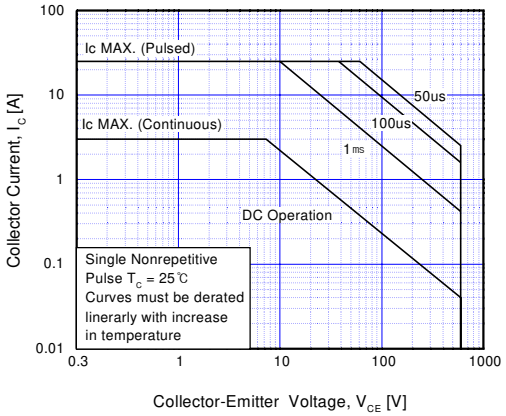

Fig 15. SOA Characteristics

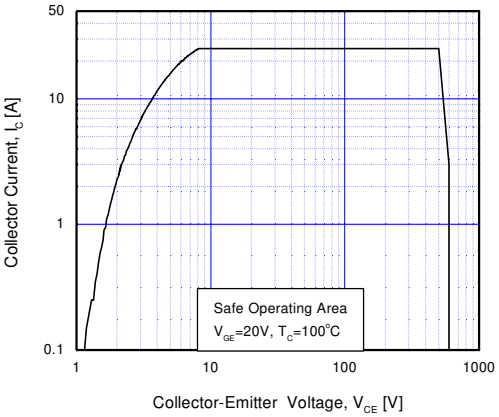

Fig 16. Turn-Off SOA Characteristics

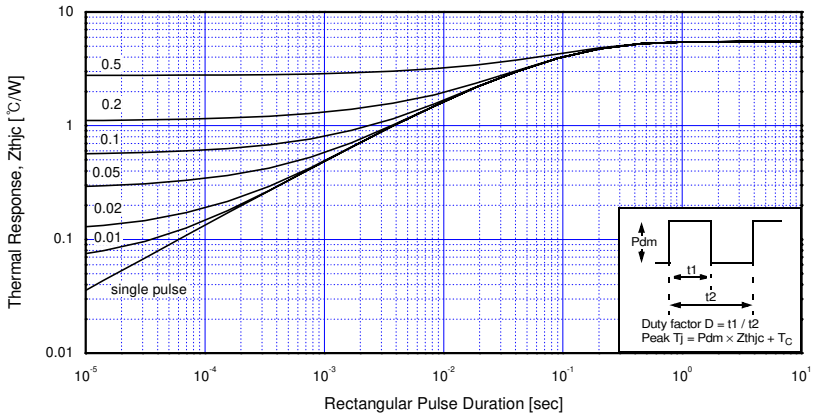

Fig 17. Transient Thermal Impedance of IGBT

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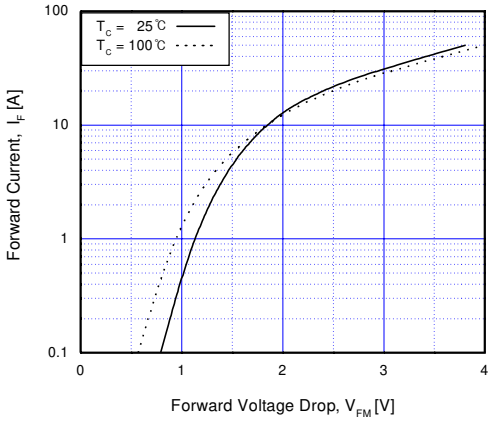

Fig 18. Forward Characteristics

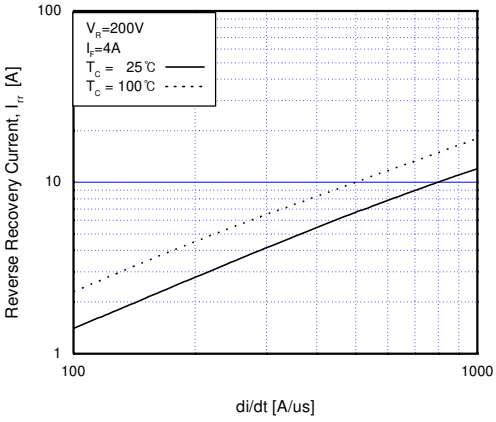

Fig 19. Reverse Recovery Current

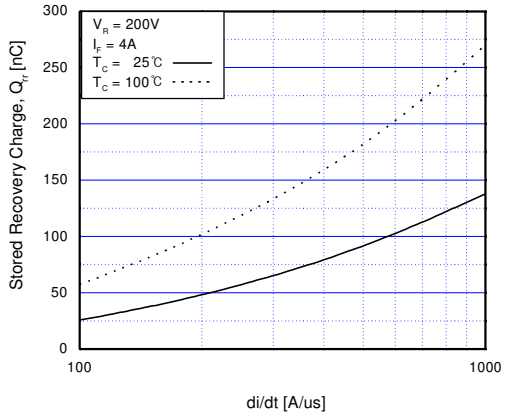

Fig 20. Stored Charge

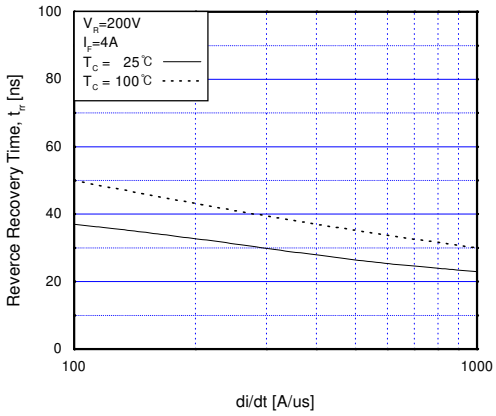

Fig 21. Reverse Recovery Time

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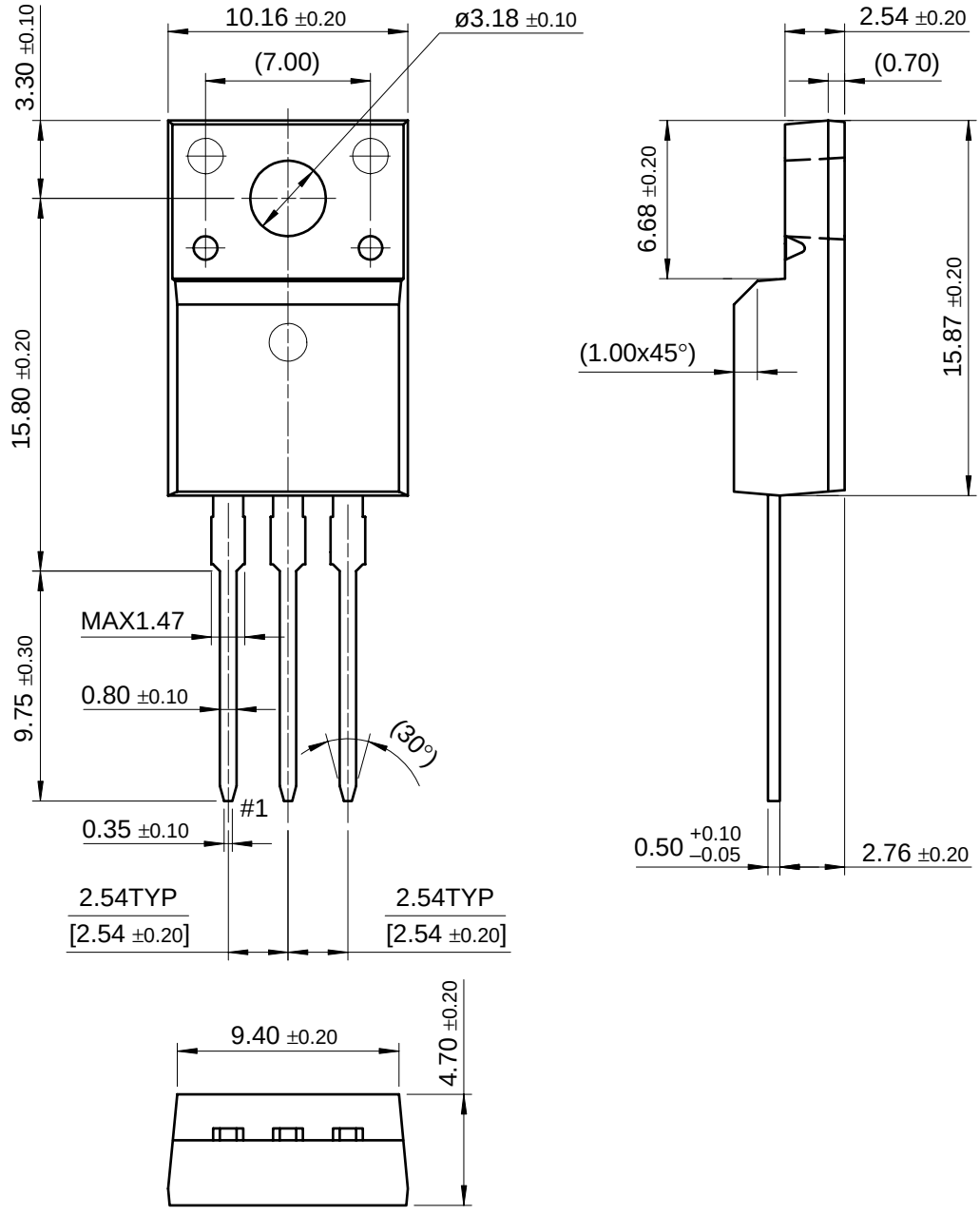
Package Dimension

TO-220F (FS PKG CODE AQ)



Dimensions in Millimeters

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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.

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SGS6N60UFD

Discrete, High Performance IGBT with Diode

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General description

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- Low saturation voltage : $V_{CE(sat)}$ = 2.1 V @ I_C = 3A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 35ns (typ.)

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Applications

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

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Product status/pricing/packaging

Product	Product status	Pricing*	Package type	Leads	Packing method
SGS6N60UFDTU	Full Production	$0.95	TO-220F	3	RAIL

* 1,000 piece Budgetary Pricing

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