FAIRCHILD
SEMICONDUCTOR®

IGBT

FGAF40N60UFD

Ultrafast IGBT

General Description

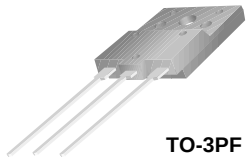
Fairchild's UFD series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UFD series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

Features

- High speed switching
- Low saturation voltage : $V_{CE(sat)}$ = 2.3 V @ I_C = 20A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 50ns (typ.)

Applications

AC & DC motor controls, general purpose inverters, robotics, and servo controls.



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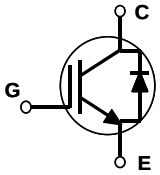


Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

Symbol	Description		FGAF40N60UFD	Units
V_{CES}	Collector-Emitter Voltage		600	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Collector Current	@ T_C = 25°C	40	A
	Collector Current	@ T_C = 100°C	20	A
$I_{CM\ (1)}$	Pulsed Collector Current		160	A
I_F	Diode Continuous Forward Current	@ T_C = 100°C	15	A
I_{FM}	Diode Maximum Forward Current		160	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	100	W
	Maximum Power Dissipation	@ T_C = 100°C	40	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	--	1.2	°C/W
$R_{\theta JC}$(DIODE)	Thermal Resistance, Junction-to-Case	--	2.6	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	°C/W

Electrical Characteristics of the 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 Coefficient 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	nA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	I_C = 20mA, V_{CE} = V_{GE}	3.5	5.1	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 20A, V_{GE} = 15V	--	2.3	3.0	V
		I_C = 40A, V_{GE} = 15V	--	3.1	--	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30V, V_{GE} = 0V, f = 1MHz	--	1075	--	pF
C_{oes}	Output Capacitance		--	170	--	pF
C_{res}	Reverse Transfer Capacitance		--	50	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 20A, R_G = 10Ω, V_{GE} = 15V, Inductive Load, T_C = 25°C	--	15	--	ns
t_r	Rise Time		--	30	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	65	130	ns
t_f	Fall Time		--	35	100	ns
E_{on}	Turn-On Switching Loss		--	470	--	uJ
E_{off}	Turn-Off Switching Loss		--	130	--	uJ
E_{ts}	Total Switching Loss		--	600	1000	uJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 20A, R_G = 10Ω, V_{GE} = 15V, Inductive Load, T_C = 125°C	--	30	--	ns
t_r	Rise Time		--	37	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	110	200	ns
t_f	Fall Time		--	80	250	ns
E_{on}	Turn-On Switching Loss		--	500	--	uJ
E_{off}	Turn-Off Switching Loss		--	310	--	uJ
E_{ts}	Total Switching Loss		--	810	1200	uJ
Q_g	Total Gate Charge	V_{CE} = 300 V, I_C = 20A, V_{GE} = 15V	--	77	150	nC
Q_{ge}	Gate-Emitter Charge		--	20	30	nC
Q_{gc}	Gate-Collector Charge		--	25	40	nC
L_e	Internal Emitter Inductance	Measured 5mm from PKG	--	14	--	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 = 15A	T_C = 25°C	--	1.4	1.7	V
			T_C = 100°C	--	1.3	--	
t_{rr}	Diode Reverse Recovery Time	I_F = 15A, di/dt = 200A/us	T_C = 25°C	--	50	95	ns
			T_C = 100°C	--	74	--	
I_{rr}	Diode Peak Reverse Recovery Current		T_C = 25°C	--	4.5	6.0	A
			T_C = 100°C	--	6.5	--	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	--	80	180	nC
			T_C = 100°C	--	220	--	

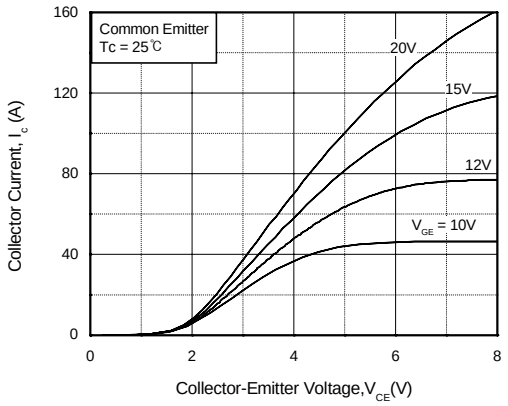


Fig 1. Typical Output Characteristics

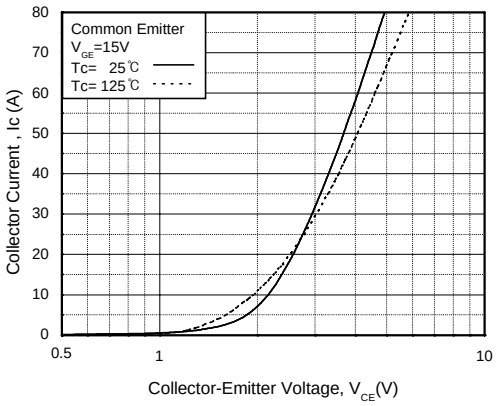


Fig 2. Typical Saturation Voltage Characteristics

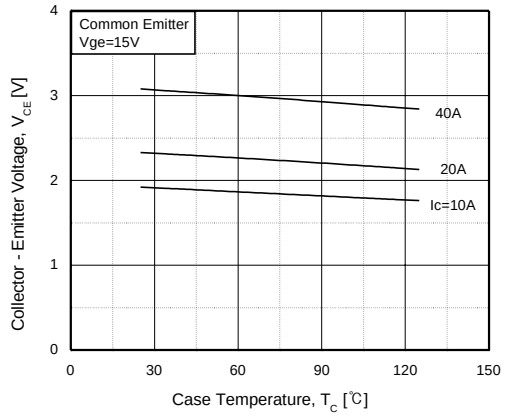


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

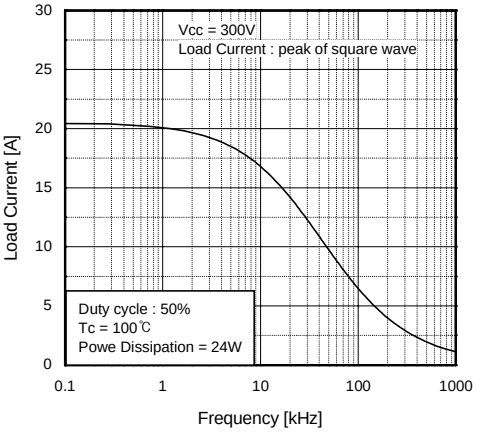


Fig 4. Load Current vs. Frequency

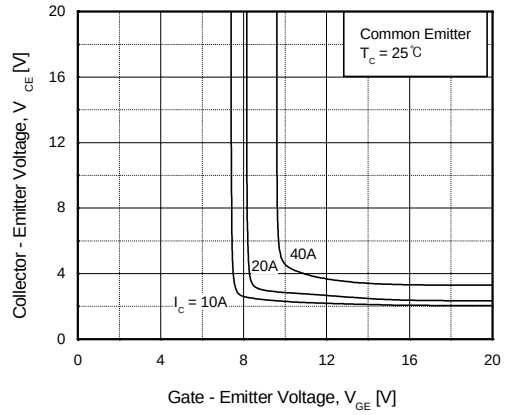


Fig 5. Saturation Voltage vs. V_{GE}

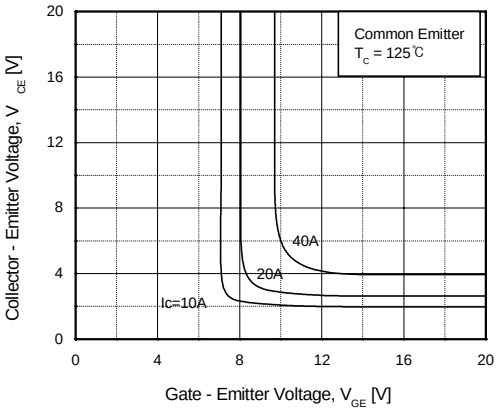


Fig 6. Saturation Voltage vs. V_{GE}

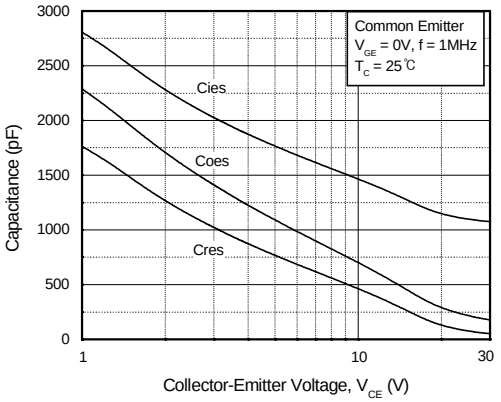


Fig 7. Capacitance Characteristics

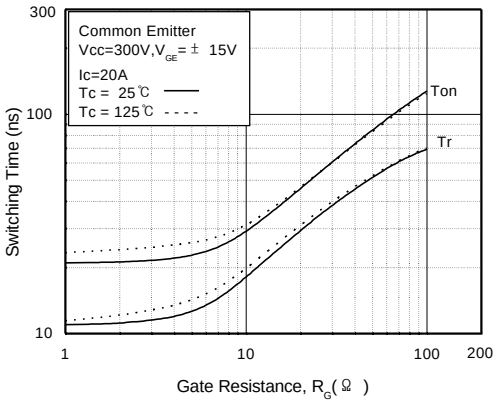


Fig 8. Turn-On Characteristics vs. Gate Resistance

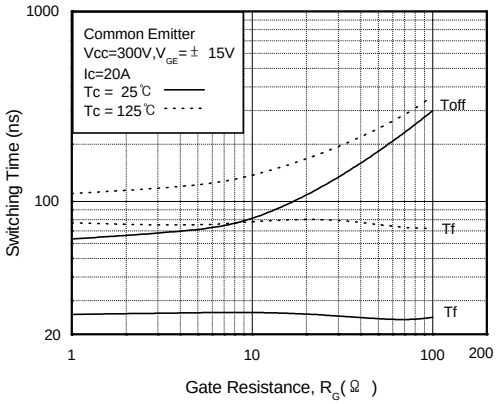


Fig 9. Turn-Off Characteristics vs. Gate Resistance

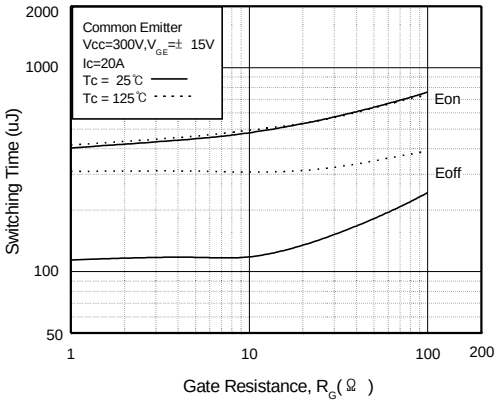


Fig 10. Switching Loss vs. Gate Resistance

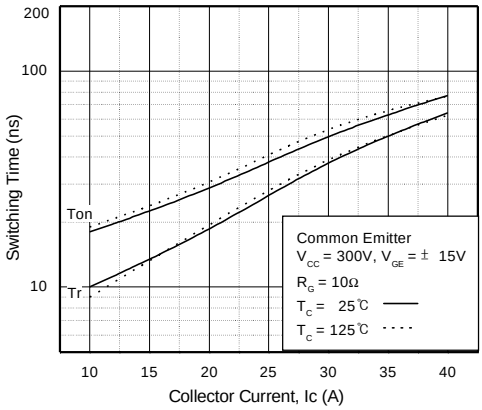


Fig 11. Turn-On Characteristics vs. Collector Current

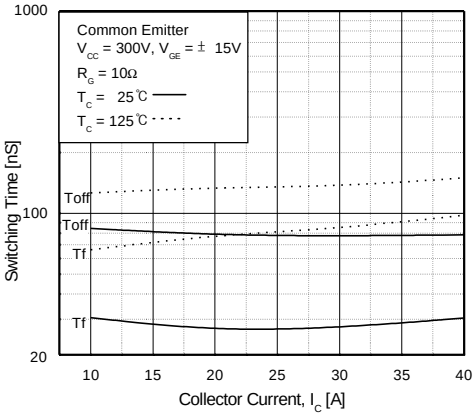


Fig 12. Turn-Off Characteristics vs. Collector Current

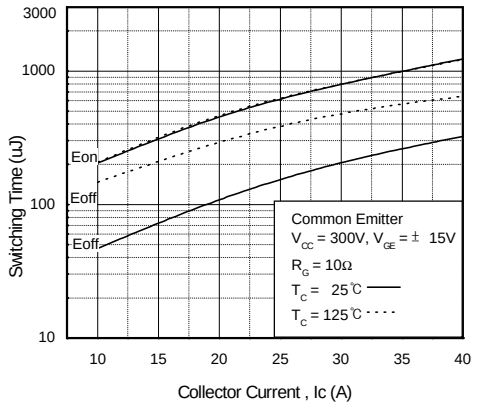


Fig 13. Switching Loss vs. Collector Current

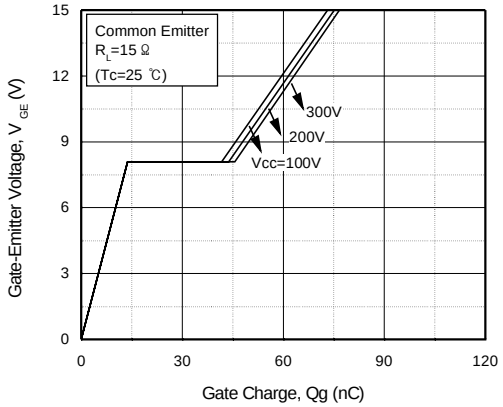


Fig 14. Gate Charge Characteristics

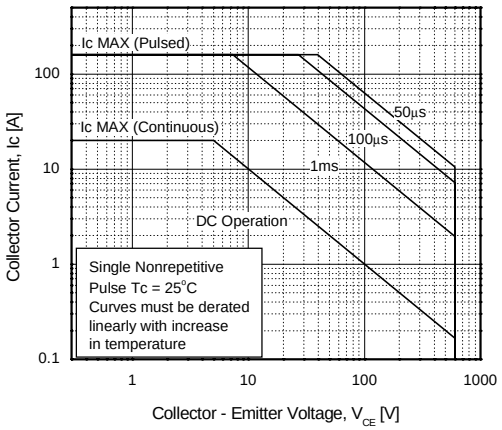


Fig 15. SOA Characteristics

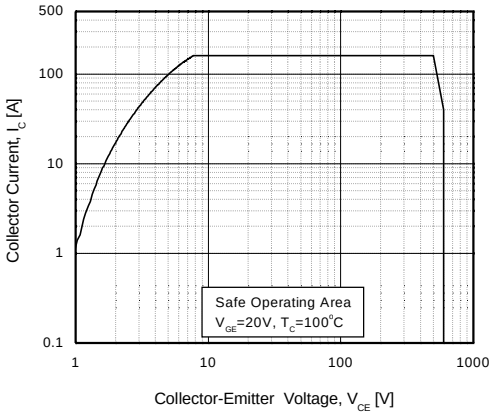


Fig 16. Turn-Off SOA Characteristics

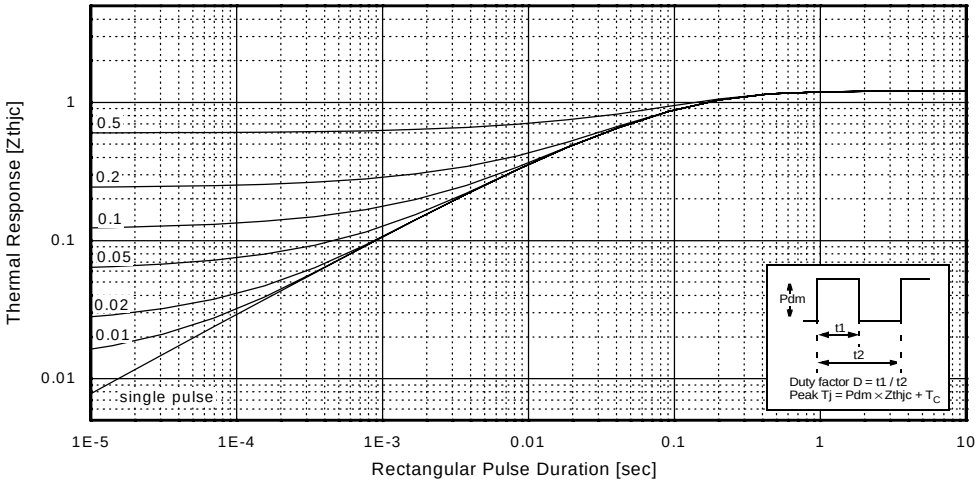


Fig 17. Transient Thermal Impedance of IGBT

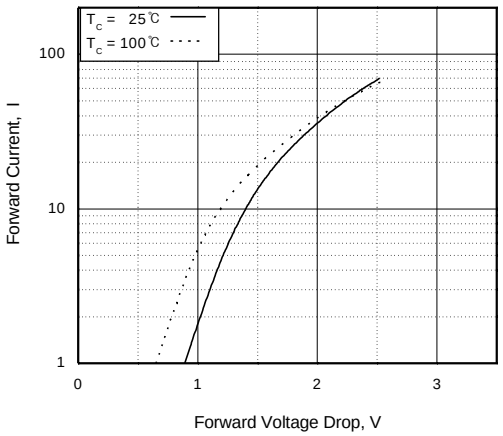


Fig 18. Forward Characteristics

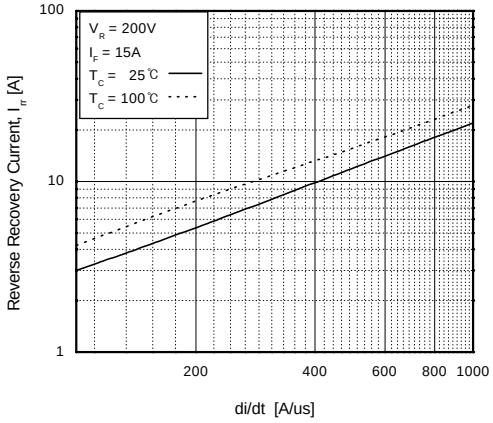


Fig 19. Reverse Recovery Current

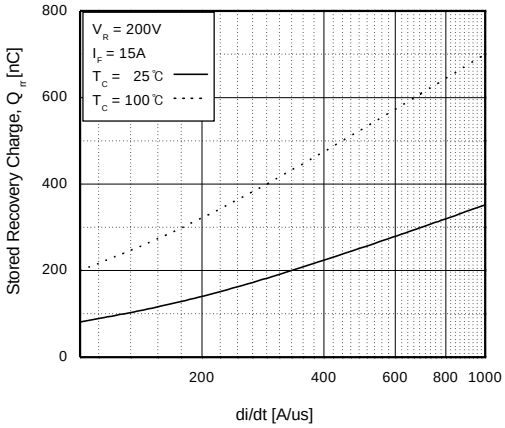


Fig 20. Stored Charge

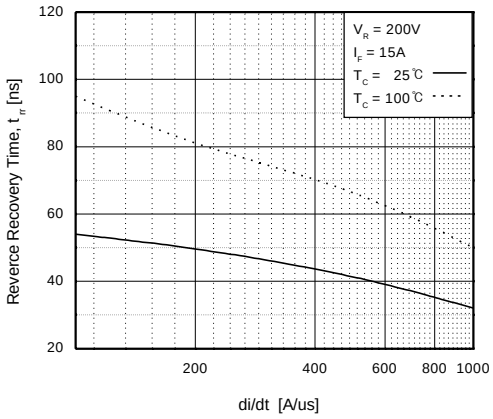
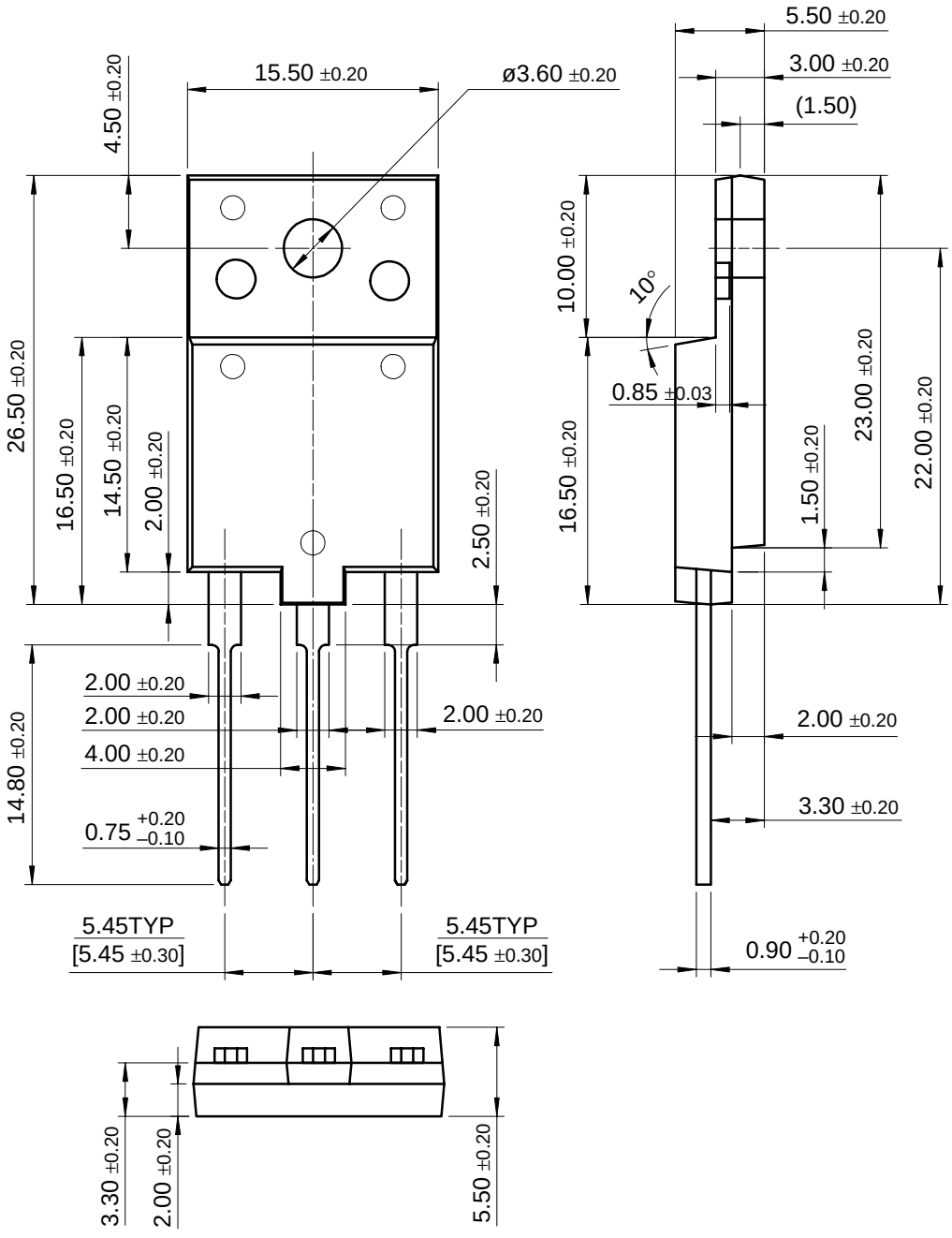


Fig 21. Reverse Recovery Time

Package Dimensions

TO-3PF



Dimensions in Millimeters

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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.

FGAF40N60UFD

Ultrafast IGBT

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This page

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back to top

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back to top

Applications

- AC & DC motor controls, general purpose inverters, robotics, and servo controls.

back to top

Product status/pricing/packaging BUY

Product	Product status	Pb-free Status	Pricing*	Package type	Leads	Packing method	Package Marking Convention**
FGAF40N60UFDTU	Full Production	Full Production	$3.90	TO-3PF	3	RAIL	Line 1: **$Y** (Fairchild logo)

* Fairchild 1,000 piece Budgetary Pricing
** A sample button will appear if the part is available through Fairchild's on-line samples program. If there is no sample button, please contact a Fairchild distributor to obtain samples

Indicates product with Pb-free second-level interconnect. For more information click here.

Package marking information for product FGAF40N60UFD is available. Click here for more information .

back to top

Qualification Support

Click on a product for detailed qualification data

Product
FGAF40N60UFDTU

back to top