

FAIRCHILD
SEMICONDUCTOR®

IGBT

FGAF40N60UFD

Ultrafast IGBT

General Description

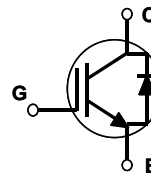
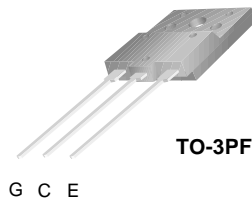
Fairchild's UFD series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UFD series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

Features

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

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

FGAF40N60UFD

Electrical Characteristics of the IGBT $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{CES}	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	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	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	$I_C = 20mA, V_{CE} = V_{GE}$	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	$V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	--	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	--	μJ
E_{off}	Turn-Off Switching Loss		--	130	--	μJ
E_{ts}	Total Switching Loss	--	600	1000	μJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ C$	--	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	--	μJ
E_{off}	Turn-Off Switching Loss		--	310	--	μJ
E_{ts}	Total Switching Loss	--	810	1200	μJ	
Q_{ge}	Total Gate Charge	$V_{CE} = 300V, I_C = 20A,$ $V_{GE} = 15V$	--	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 $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
V_{FM}	Diode Forward Voltage	$I_F = 15A$	$T_C = 25^\circ C$	--	1.4	1.7	V
			$T_C = 100^\circ C$	--	1.3	--	
t_{rr}	Diode Reverse Recovery Time	$I_F = 15A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	50	95	ns
			$T_C = 100^\circ C$	--	74	--	
I_{rr}	Diode Peak Reverse Recovery Current	$I_F = 15A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	4.5	6.0	A
			$T_C = 100^\circ C$	--	6.5	--	
Q_{rr}	Diode Reverse Recovery Charge	$I_F = 15A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	80	180	nC
			$T_C = 100^\circ C$	--	220	--	

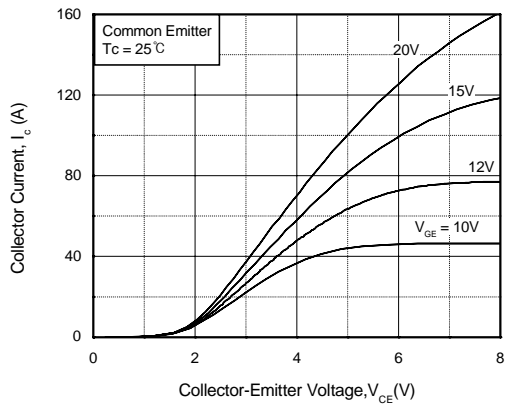


Fig 1. Typical Output Characteristics

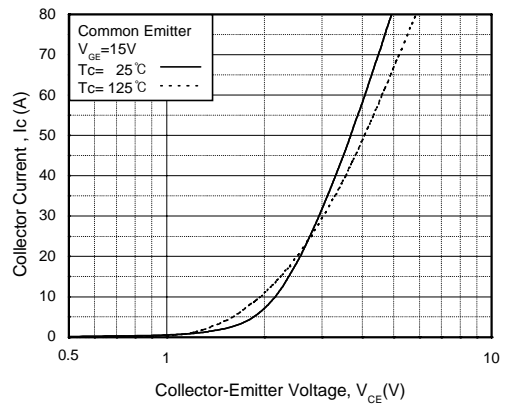


Fig 2. Typical Saturation Voltage Characteristics

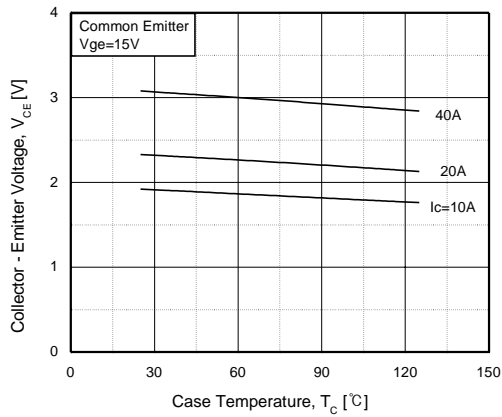


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

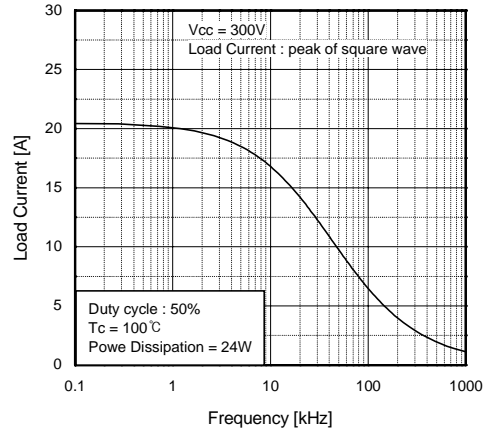


Fig 4. Load Current vs. Frequency

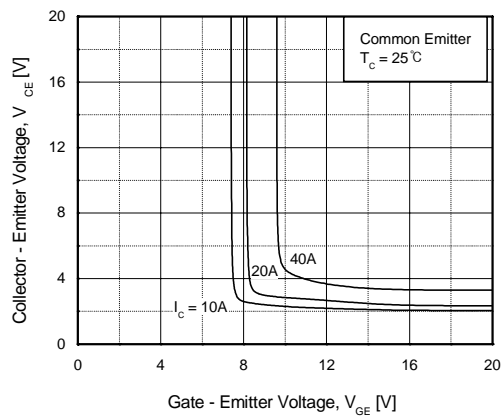


Fig 5. Saturation Voltage vs. V_{GE}

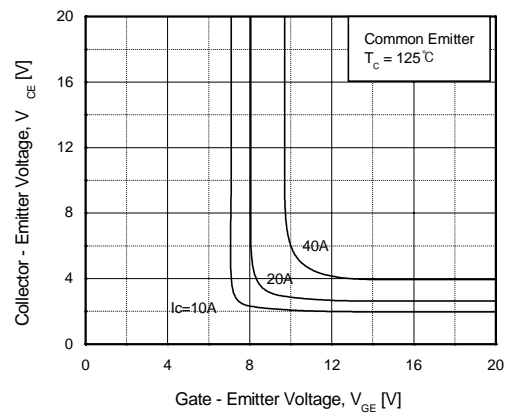


Fig 6. Saturation Voltage vs. V_{GE}

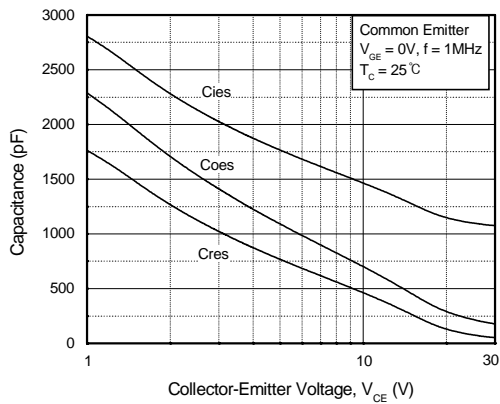


Fig 7. Capacitance Characteristics

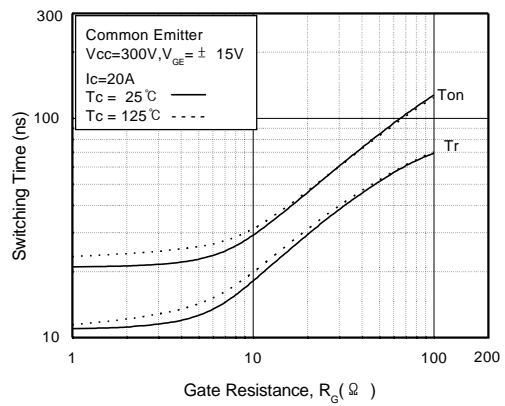


Fig 8. Turn-On Characteristics vs. Gate Resistance

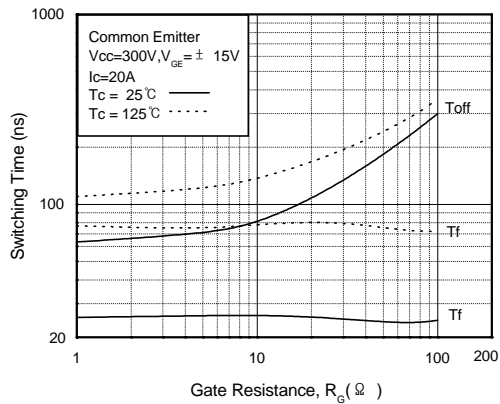


Fig 9. Turn-Off Characteristics vs. Gate Resistance

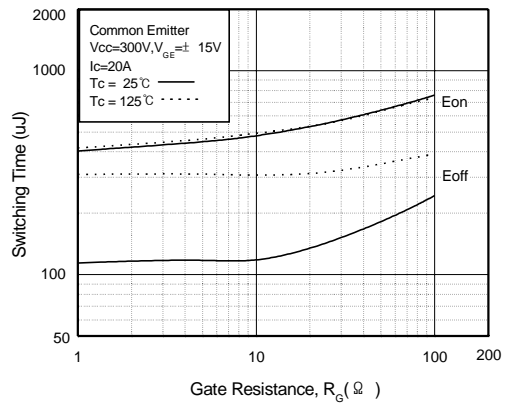


Fig 10. Switching Loss vs. Gate Resistance

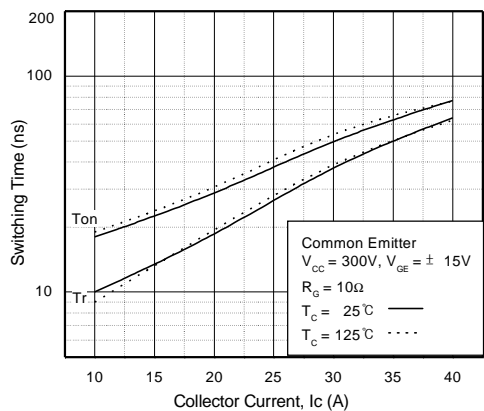


Fig 11. Turn-On Characteristics vs. Collector Current

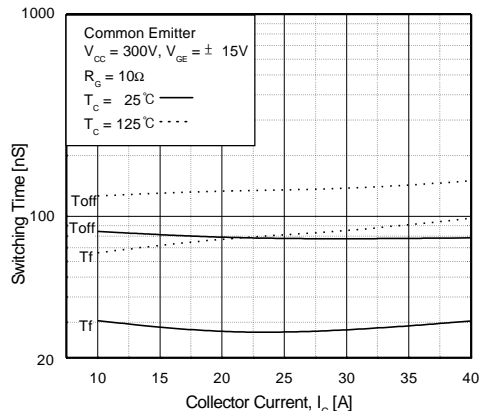


Fig 12. Turn-Off Characteristics vs. Collector Current

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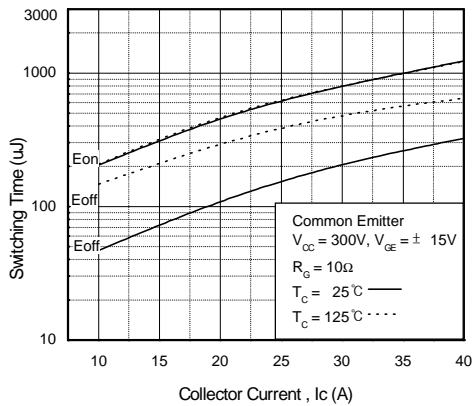


Fig 13. Switching Loss vs. Collector Current

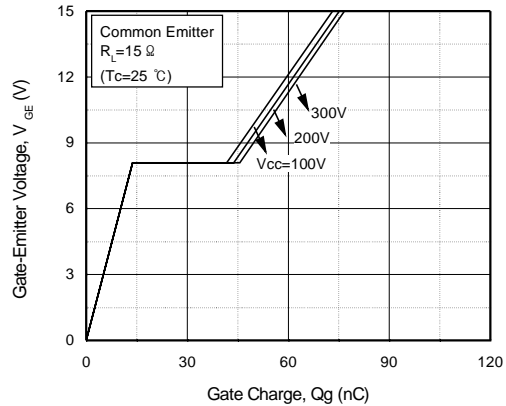


Fig 14. Gate Charge Characteristics

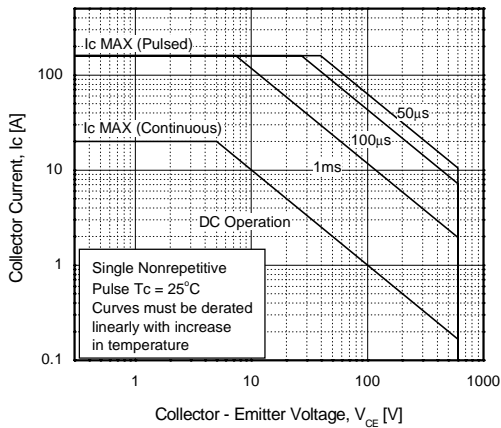


Fig 15. SOA Characteristics

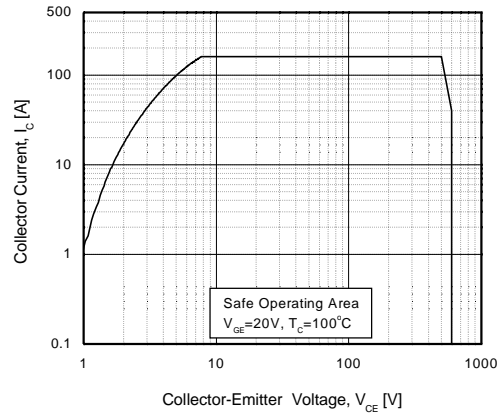


Fig 16. Turn-Off SOA Characteristics

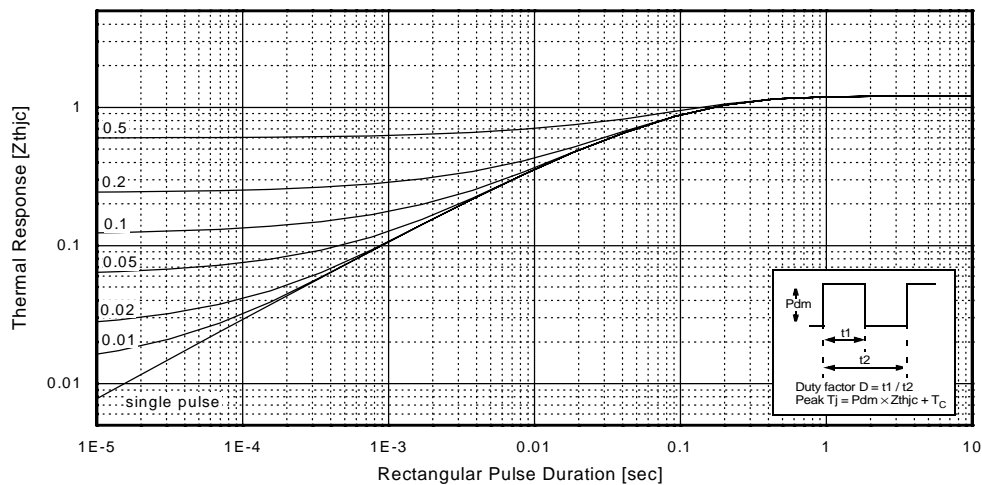


Fig 17. Transient Thermal Impedance of IGBT

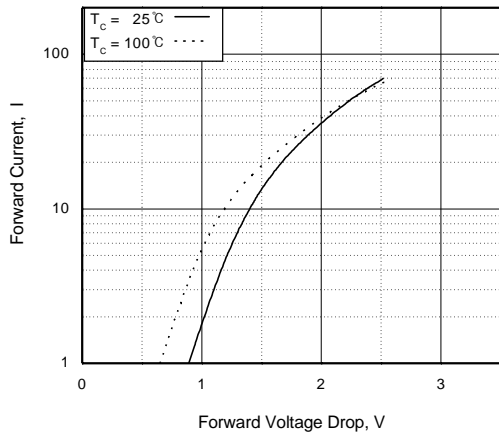


Fig 18. Forward Characteristics

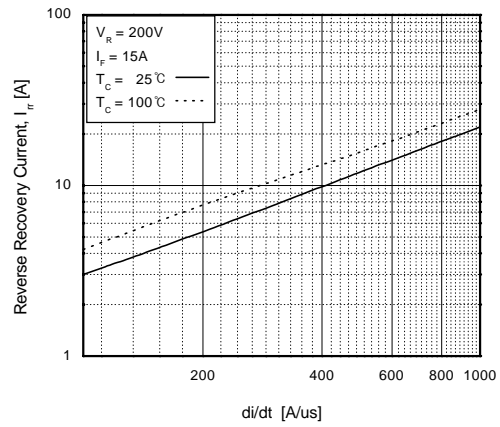


Fig 19. Reverse Recovery Current

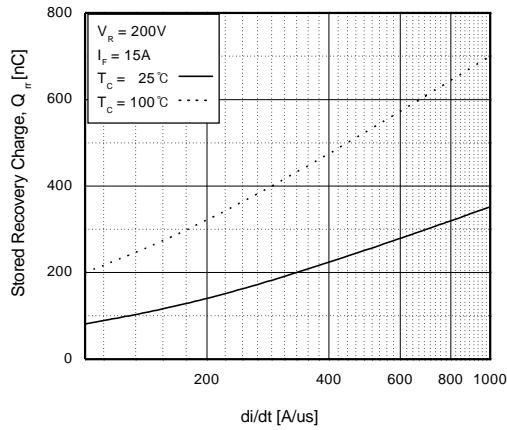


Fig 20. Stored Charge

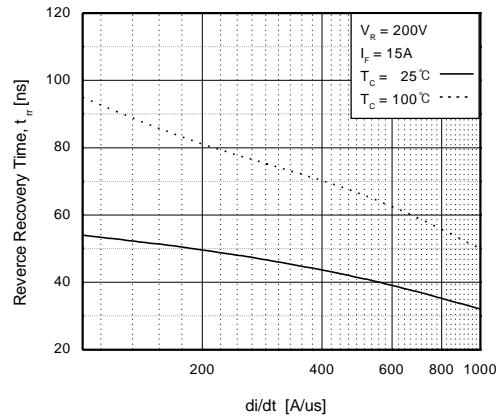
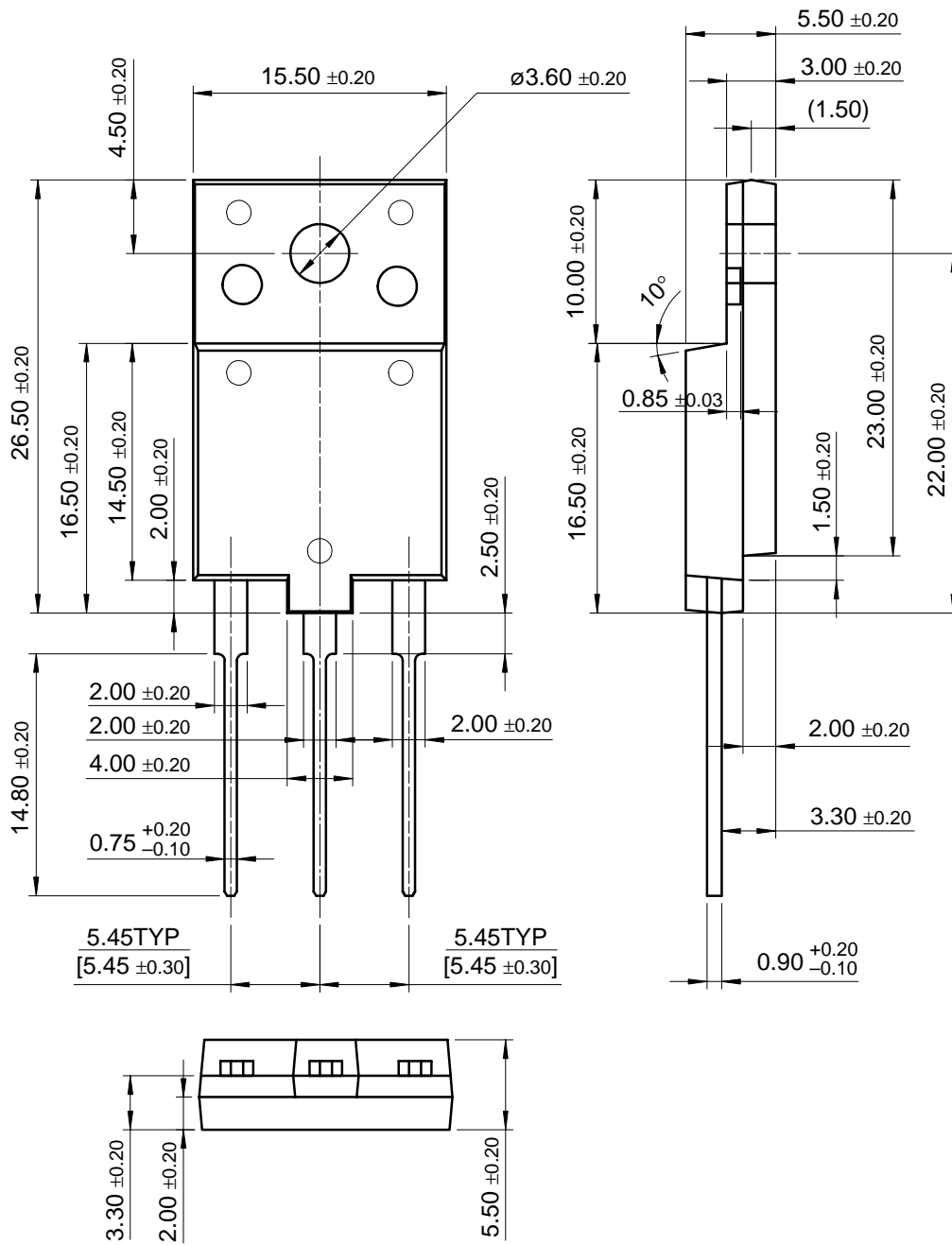


Fig 21. Reverse Recovery Time

Package Dimensions

TO-3PF



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Dimensions in Millimeters

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