FAIRCHILD

SEMICONDUCTOR®

IGBT

SGU2N60UFD

Ultra-Fast IGBT
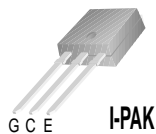
General Description

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 = 1.2A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 45ns (typ.)

Applications

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

G C E   **I-PAK**

C

G

E

Absolute Maximum Ratings $T_C = 25°C$ unless otherwise noted

Symbol	Description		SGU2N60UFD	Units
V_{CES}	Collector-Emitter Voltage		600	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Collector Current	@ T_C = 25°C	2.4	A
	Collector Current	@ T_C = 100°C	1.2	A
$I_{CM\,(1)}$	Pulsed Collector Current		10	A
I_F	Diode Continuous Forward Current	@ T_C = 100°C	1.5	A
I_{FM}	Diode Maximum Forward Current		12	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	25	W
	Maximum Power Dissipation	@ T_C = 100°C	10	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	--	5.0	°C/W
$R_{\theta JC}$(DIODE)	Thermal Resistance, Junction-to-Case	--	5.0	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	110	°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	$I_C = 1.2mA$, $V_{CE} = V_{GE}$	3.5	4.5	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 1.2A$, $V_{GE} = 15V$	--	2.1	2.6	V
		$I_C = 2.4A$, $V_{GE} = 15V$	--	2.6	--	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	$V_{CE} = 30V$, $V_{GE} = 0V$, f = 1MHz	--	98	--	pF
C_{oes}	Output Capacitance		--	18	--	pF
C_{res}	Reverse Transfer Capacitance		--	4	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300$ V, $I_C = 1.2A$, $R_G = 200\Omega$, $V_{GE} = 15V$, Inductive Load, $T_C = 25°C$	--	15	--	ns
t_r	Rise Time		--	20	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	80	130	ns
t_f	Fall Time		--	95	160	ns
E_{on}	Turn-On Switching Loss		--	30	--	uJ
E_{off}	Turn-Off Switching Loss		--	13	--	uJ
E_{ts}	Total Switching Loss		--	43	70	uJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300$ V, $I_C = 1.2A$, $R_G = 200\Omega$, $V_{GE} = 15V$, Inductive Load, $T_C = 125°C$	--	19	--	ns
t_r	Rise Time		--	24	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	115	200	ns
t_f	Fall Time		--	176	250	ns
E_{on}	Turn-On Switching Loss		--	36	--	uJ
E_{off}	Turn-Off Switching Loss		--	27	--	uJ
E_{ts}	Total Switching Loss		--	63	100	uJ
Q_g	Total Gate Charge	$V_{CE} = 300$ V, $I_C = 1.2A$, $V_{GE} = 15V$	--	9	14	nC
Q_{ge}	Gate-Emitter Charge		--	3	5	nC
Q_{gc}	Gate-Collector Charge		--	1.5	3	nC
L_e	Internal Emitter Inductance	Measured 5mm from PKG	--	7.5	--	nH

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

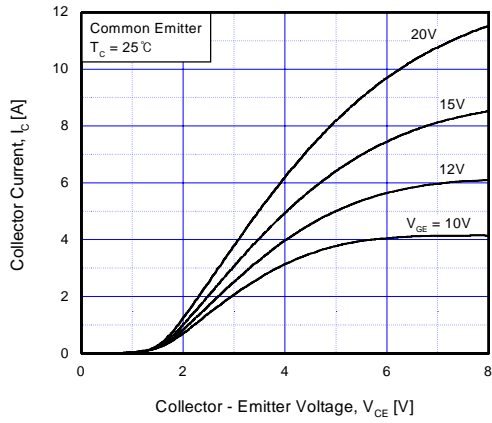| Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_{FM}	Diode Forward Voltage	$I_F = 2A$	$T_C = 25°C$	--	1.4	1.7	V
			$T_C = 100°C$	--	1.3	--	
t_{rr}	Diode Reverse Recovery Time	$I_F = 2A$, di/dt = 200A/us	$T_C = 25°C$	--	45	80	ns
			$T_C = 100°C$	--	75	--	
I_{rr}	Diode Peak Reverse Recovery Current		$T_C = 25°C$	--	1.5	3.0	A
			$T_C = 100°C$	--	2.5	--	
Q_{rr}	Diode Reverse Recovery Charge		$T_C = 25°C$	--	60	135	nC
			$T_C = 100°C$	--	120	--	

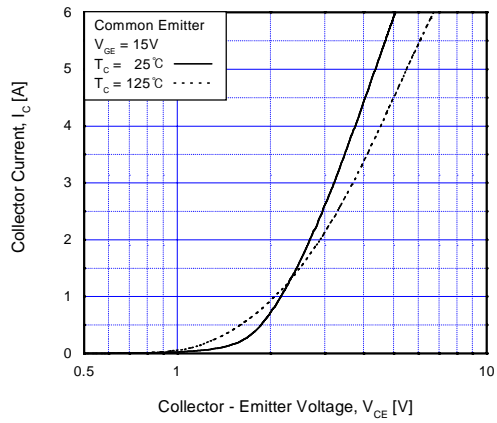**Fig 1. Typical Output Characteristics**

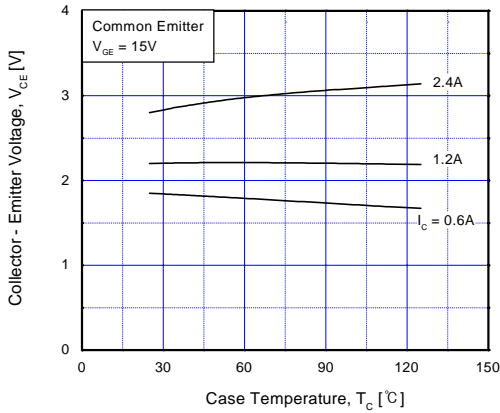**Fig 2. Typical Saturation Voltage Characteristics**

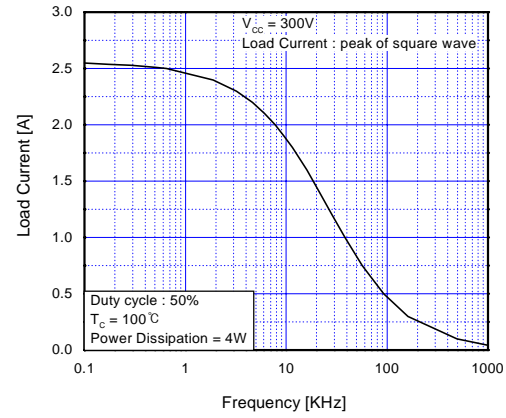**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**
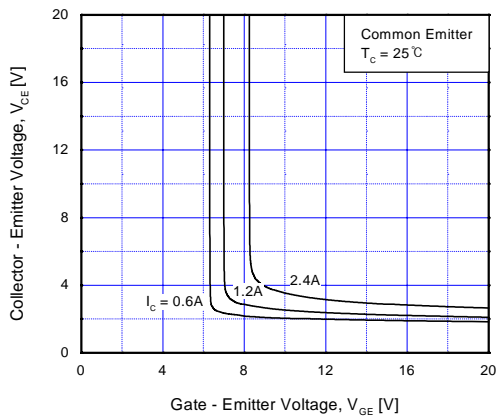
Fig 4. Load Current vs. Frequency

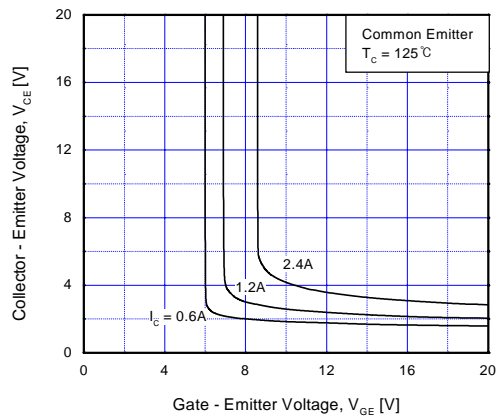**Fig 5. Saturation Voltage vs. V$_{GE}$**
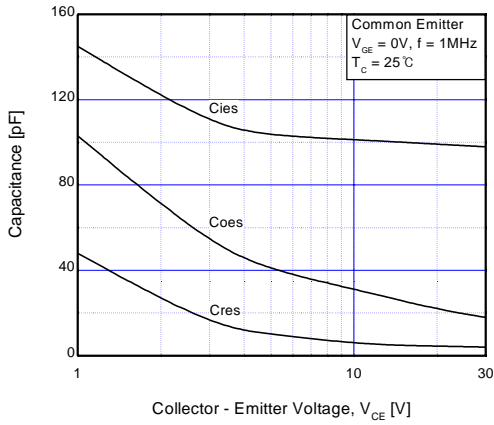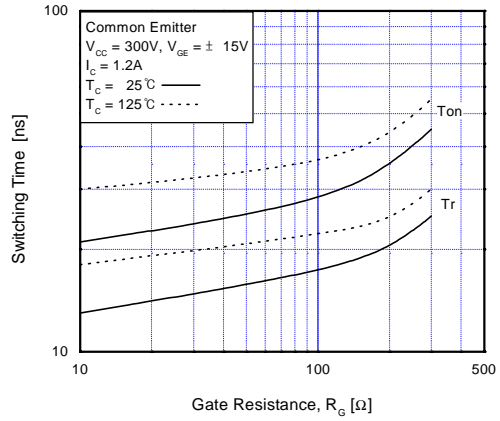
Fig 6. Saturation Voltage vs. V$_{GE}$

Fig 7. Capacitance Characteristics
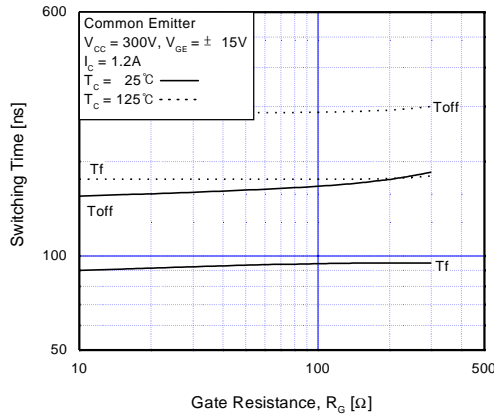
Fig 8. Turn-On Characteristics vs.
Gate Resistance
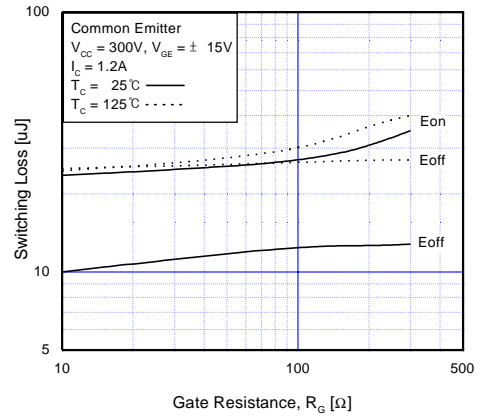
Fig 9. Turn-Off Characteristics vs.
Gate Resistance
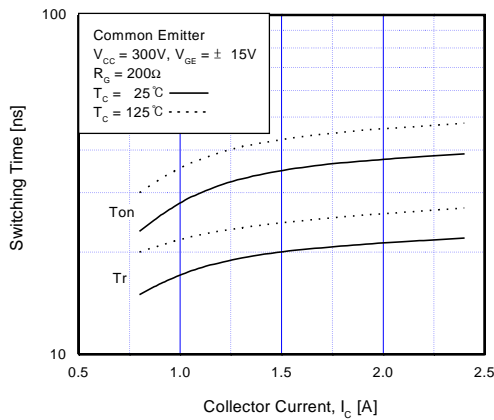
Fig 10. Switching Loss vs. Gate Resistance

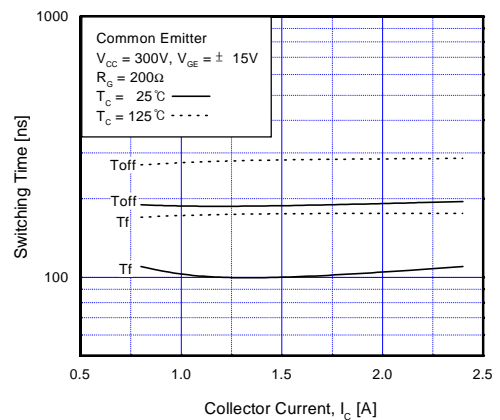Fig 11. Turn-On Characteristics vs.
Collector Current

Fig 12. Turn-Off Characteristics vs.
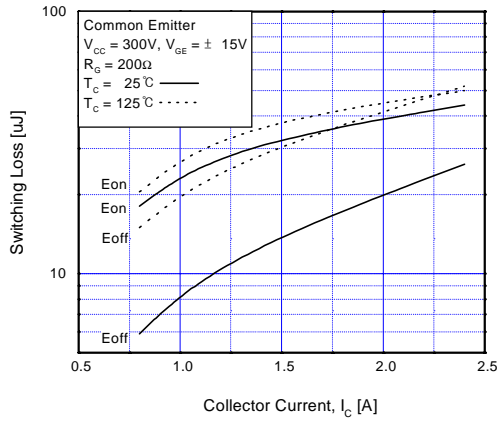Collector Current
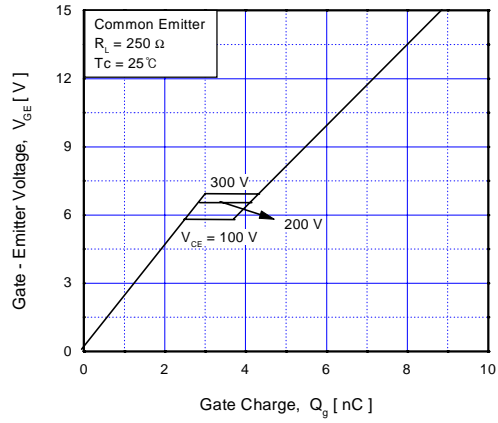
Fig 13. Switching Loss vs. Collector Current

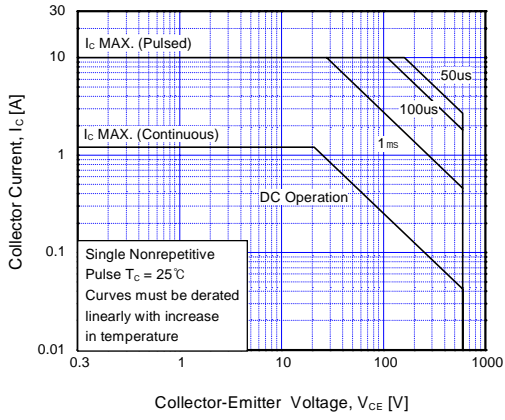Fig 14. Gate Charge Characteristics
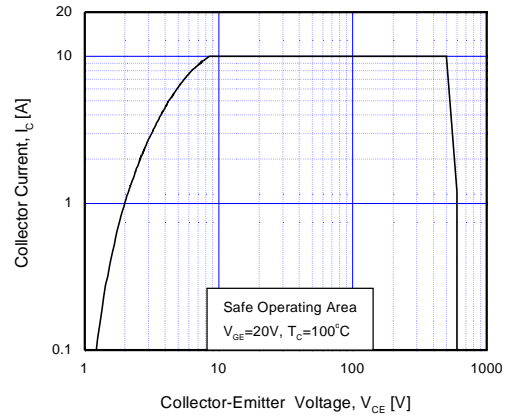
Fig 15. SOA Characteristics

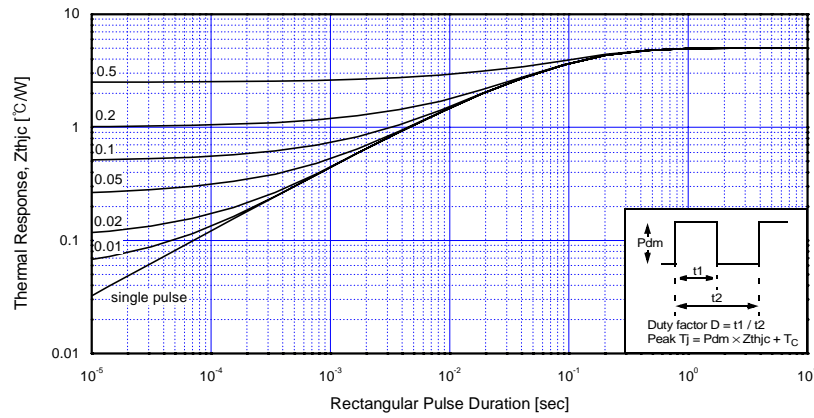Fig 16. Turn-Off SOA Characteristics

Fig 17. Transient Thermal Impedance of IGBT
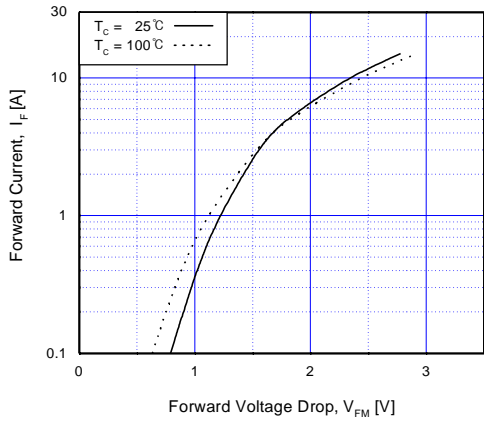
Fig 18. Forward Characteristics

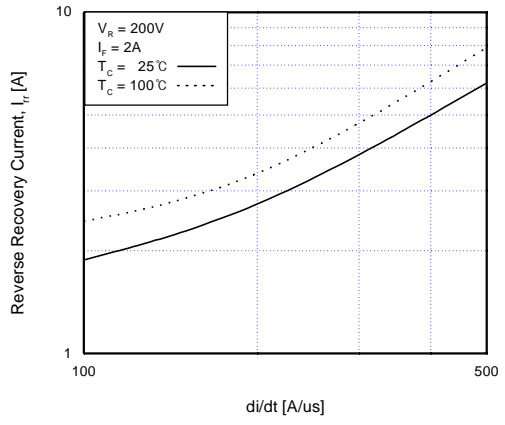**Fig 19. Reverse Recovery Current**
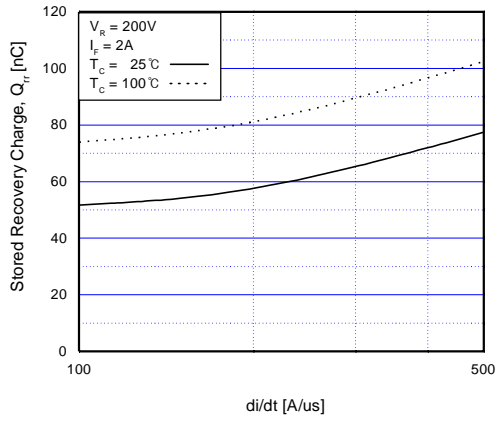
Fig 20. Stored Charge
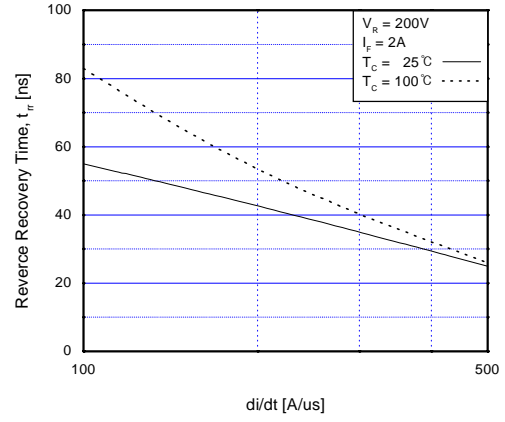
Fig 21. Reverse Recovery Time

Package Dimension

I-PAK

6.60 ±0.20

5.34 ±0.20

(0.50) (4.34) (0.50)

0.60 ±0.20

0.70 ±0.20

6.10 ±0.20

0.80 ±0.10

MAX0.96

1.80 ±0.20

0.76 ±0.10

9.30 ±0.30

2.30TYP
[2.30±0.20]

2.30TYP
[2.30±0.20]

2.30 ±0.20

0.50 ±0.10

16.10 ±0.30

0.50 ±0.10

Dimensions in Millimeters

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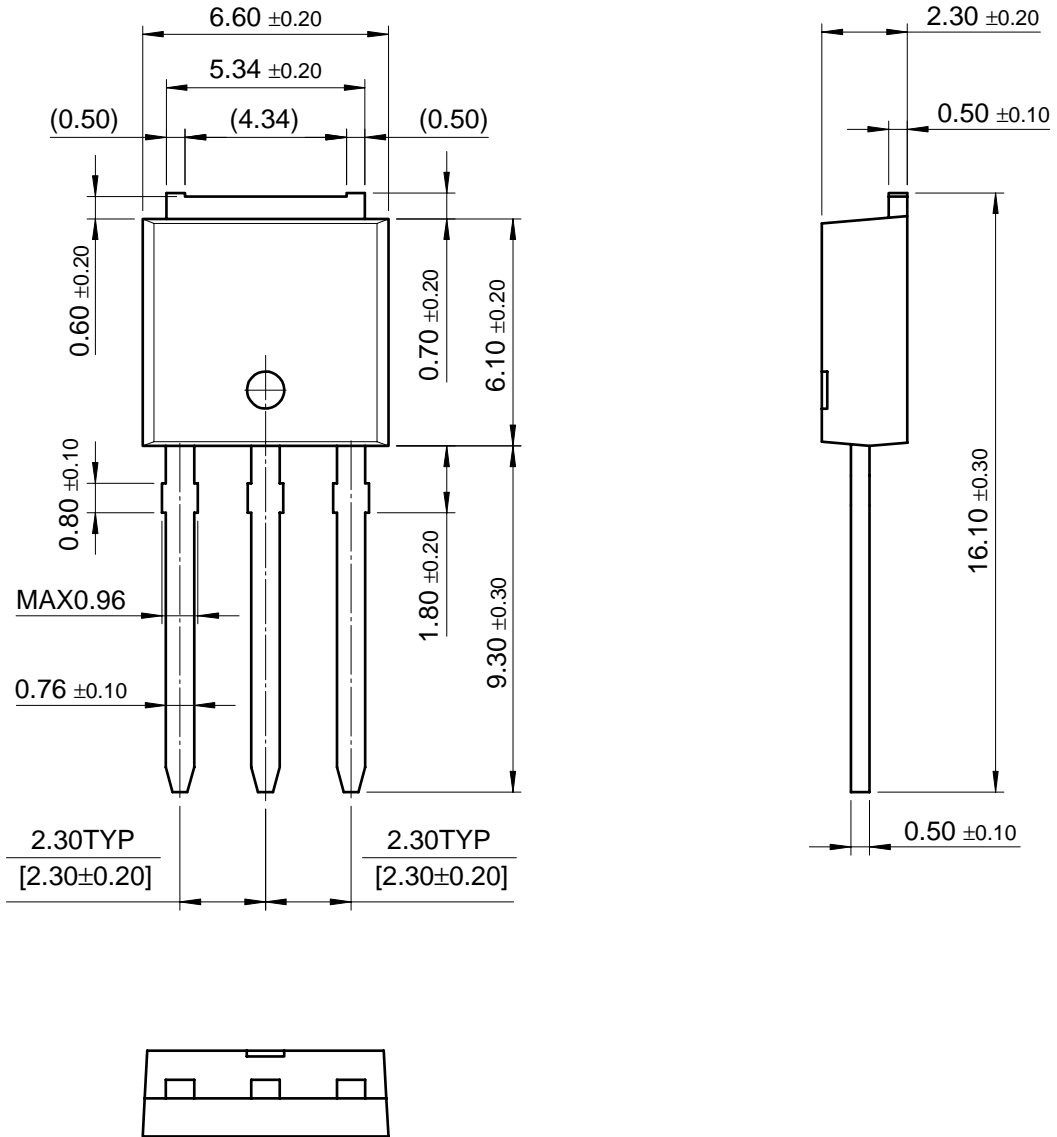|				
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Bottomless™	FASTr™	OPTOLOGIC™	SMART START™	UltraFET®
CoolFET™	FRFET™	OPTOPLANAR™	SPM™	VCX™
CROSSVOLT™	GlobalOptoisolator™	PACMAN™	STAR*POWER™	
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DOME™	HiSeC™	Power247™	SuperSOT™-3	
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No 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.
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