

## FGPF10N60UNDF-VB Datasheet

### 600V Trench and Fieldstop IGBT

PRODUCT SUMMARY		
V <sub>CE</sub> (V)	600	
I <sub>C</sub> (A)	20 (T <sub>C</sub> =25 °C)	10 (T <sub>C</sub> =100 °C)
V <sub>CE(sat)</sub> (V)	1.7	
I <sub>CM</sub> (A)	30	

#### FEATURES

- Very Low V<sub>CEsat</sub>
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge (Q<sub>g</sub>)
- Avalanche energy rated (UIS)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

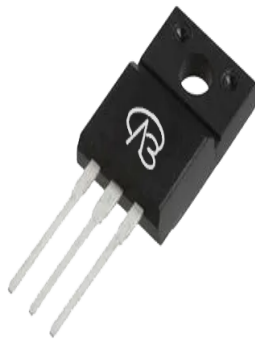
#### APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
- Renewable energy
  - Solar (PV inverters)
- Switch mode power supplies (SMPS)

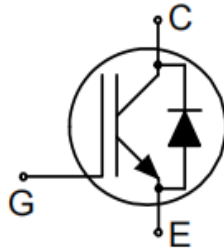
#### Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter

TO-220F



Top View



ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Collector-Emitter Voltage		V <sub>CE</sub>	600	V
Gate-Emitter Voltage		V <sub>GE</sub>	±30	
Continuous Collector Current (T <sub>J</sub> = 150 °C)	V <sub>GE</sub> at 15 V	I <sub>C</sub>	T <sub>C</sub> = 25 °C	20
			T <sub>C</sub> = 100 °C	10
Pulsed Collector Current <sup>a</sup>		I <sub>CM</sub>	30	A
Diode Forward Current <sup>b</sup>		I <sub>F</sub>	10	A
Maximum Power Dissipation		P <sub>D</sub>	T <sub>C</sub> = 25 °C	44
			T <sub>C</sub> = 100 °C	12.5
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C
Short Circuit Withstand Time <sup>TC=150</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 400V	t <sub>sc</sub>	3	μs
Short Circuit Withstand Time <sup>TC=100</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 330V		5	
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s		260	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- Current limited by maximum junction temperature.
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	78	°C/W
Maximum Junction-to-Case	$R_{thJC}$	-	3.6	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Collector-Emitter Breakdown Voltage	$BV_{CE}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		600 600	- -	- -	V
Gate-Source Threshold Voltage (N)	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_D = 250\text{ }\mu\text{A}$		4	5	6	V
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_J = 25\text{ }^\circ\text{C}$		-	1	20	$\mu\text{A}$
		$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	1000	-	$\mu\text{A}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GS} = \pm 2.0\text{ V}$		-	-	100	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 7\text{ V}$	$I_C = 7\text{ A}$	-	1.7	2.1	V
Forward Transconductance	$g_{fs}$	$V_{CE} = 20\text{ V}, I_C = 7\text{ A}$		-	15	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V},$ $f = 500\text{ KHz}$		-	1300	-	pF
Output Capacitance	$C_{oes}$			-	36	-	
Reverse Transfer Capacitance	$C_{res}$			-	2.6	-	
Turn-on Energy	$E_{on}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $I_C = 7\text{ A}, R_g = 10\text{ }\Omega$		-	0.44	-	nJ
Turn-off Energy	$E_{off}$			-	0.15	-	
Total Gate Charge	$Q_g$	$V_{GE} = 7\text{ V}$	$I_C = 7\text{ A}, V_{CE} = 400\text{ V}$	-	6.2	-	nC
Gate-Emitter Charge	$Q_{ge}$			-	13	-	
Gate to Collector Charge	$Q_{gc}$			-	22	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $I_C = 7\text{ A}, R_g = 10\text{ }\Omega$		-	19	-	ns
Rise Time	$t_r$			-	26	-	
Turn-Off Delay Time	$t_{d(off)}$			-	115	-	
Fall Time	$t_f$			-	42	-	
Internal emitter inductance measured 5 mm	$L_E$			-	13	-	nH
<b>Diode Characteristics</b>							
Diode Forward Current	$I_F$	IGBT symbol showing the integral reverse junction diode		-	-	10	A
Pulsed Diode Forward Current	$I_{FM}$			-	-	30	
Diode Forward Voltage	$V_F$	$I_F = 7\text{ A}$		-	1.72	2.0	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 7\text{ A},$ $di/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	74	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	0.38	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	9	-	A



Figure 1. **Forward bias safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ .  
Recommended use at  $V_{GE}\geq 7.5\text{V}$ )



Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )



Figure 3. **Collector current as a function of case temperature**



Figure 4. **Typical output characteristic**



Figure 5. Typical output characteristic ( $T_{vj}=150^{\circ}\text{C}$ )



Figure 6. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )



Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature



Figure 8. Typical switching times as a function of collector current

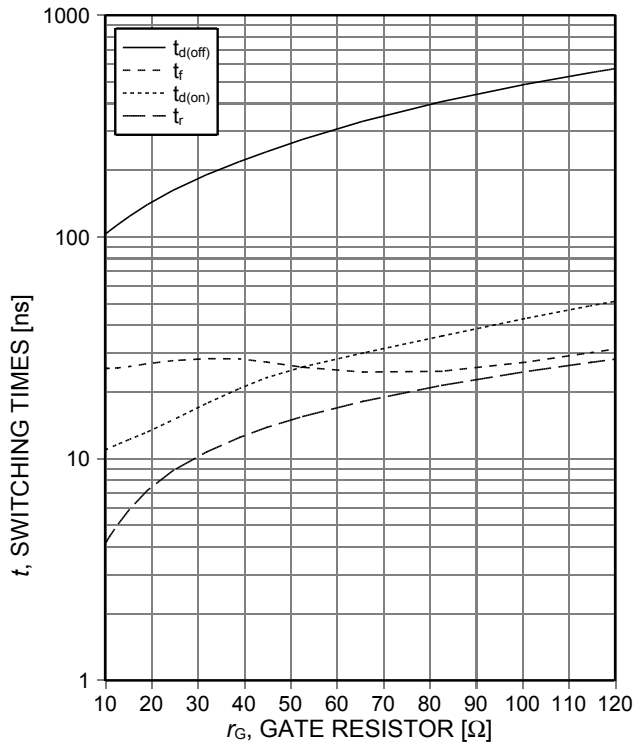


Figure 9. Typical switching times as a function of gate resistor



Figure 10. Typical switching times as a function of junction temperature



Figure 11. Gate-emitter threshold voltage as a function of junction temperature



Figure 12. Typical switching energy losses as a function of collector current



Figure 13. Typical switching energy losses as a function of gate resistor



Figure 14. Typical switching energy losses as a function of junction temperature



Figure 15. Typical switching energy losses as a function of collector emitter voltage



Figure 16. Typical gate charge



Figure 17. Typical capacitance as a function of collector-emitter voltage

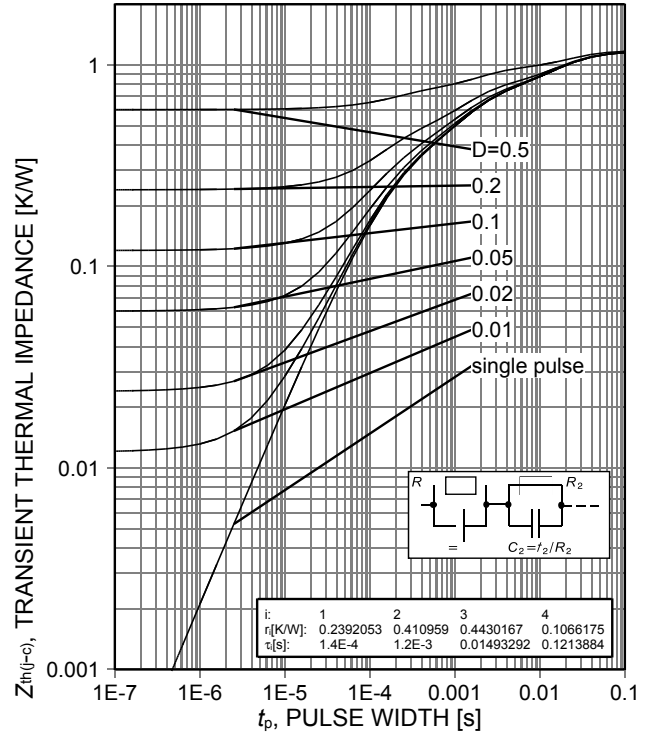


Figure 18. IGBT transient thermal impedance

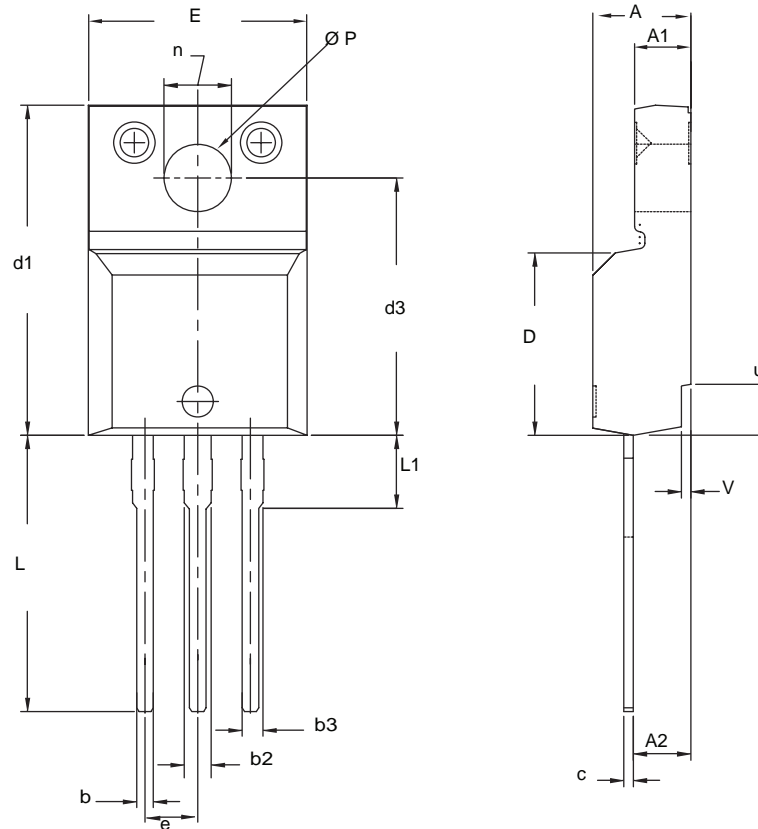


Figure 19. Diode transient thermal impedance as a function of pulse width



Figure 20. Typical reverse recovery time as a function of diode current slope

**TO-220 FULLPAK (HIGH VOLTAGE)**



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.570	4.830	0.180	0.190
A1	2.570	2.830	0.101	0.111
A2	2.510	2.850	0.099	0.112
b	0.622	0.890	0.024	0.035
b2	1.229	1.400	0.048	0.055
b3	1.229	1.400	0.048	0.055
c	0.440	0.629	0.017	0.025
D	8.650	9.800	0.341	0.386
d1	15.88	16.120	0.622	0.635
d3	12.300	12.920	0.484	0.509
E	10.360	10.630	0.408	0.419
e	2.54 BSC		0.100 BSC	
L	13.200	13.730	0.520	0.541
L1	3.100	3.500	0.122	0.138
n	6.050	6.150	0.238	0.242
Ø P	3.050	3.450	0.120	0.136
u	2.400	2.500	0.094	0.098
v	0.400	0.500	0.016	0.020

ECN: X09-0126-Rev. B, DWG: 5972

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.3
3. All critical dimensions should C meet  $C_{pk} > 1.33$ .
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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