



# THE DATASHEET OF STGP14N60D



## 14 A - 600 V - short circuit rugged IGBT

Preliminary Data

### Features

- Low on-voltage drop ( $V_{CE(sat)}$ )
- Operating junction temperature up to 175 °C
- Low  $C_{res} / C_{ies}$  ratio (no cross conduction susceptibility)
- Tight parameter distribution
- Ultra fast soft recovery antiparallel diode
- Short circuit rugged

### Applications

- Motor drives
- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies

### Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

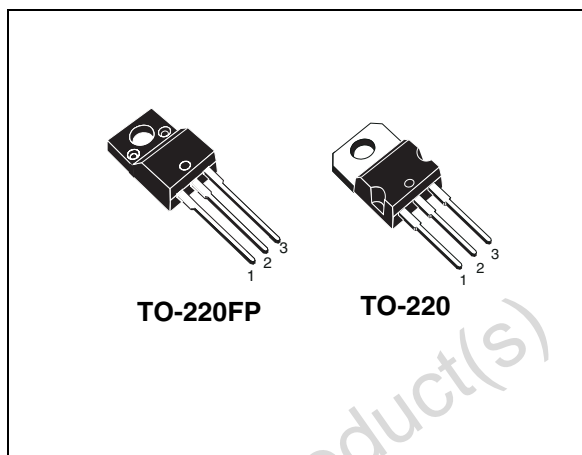


Figure 1. Internal schematic diagram

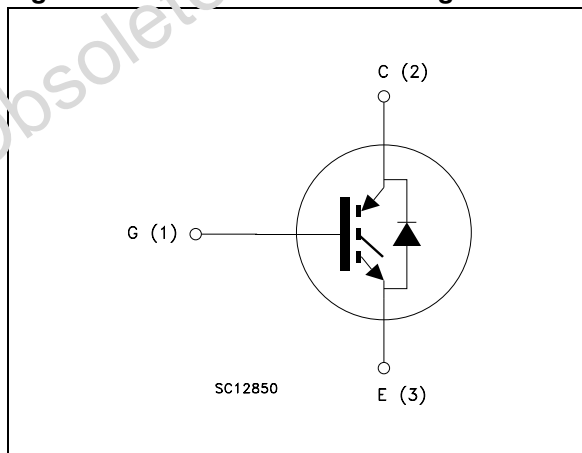


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGF14N60D	GF14N60D	TO-220FP	Tube
STGP14N60D	GP14N60D	TO-220	Tube

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Obsolete Product(s) - Obsolete Product(s)

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	600		V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25\text{ °C}$	25	11	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100\text{ °C}$	14	7	A
$I_{CL}^{(2)}$	Turn-off latching current	50		A
$I_{CP}^{(3)}$	Pulsed collector current	50		A
$V_{GE}$	Gate-emitter voltage	$\pm 20$		V
$I_F$	Diode RMS forward current at $T_C = 25\text{ °C}$	20		A
$I_{FSM}$	Surge non repetitive forward current $t_p = 10\text{ ms}$ sinusoidal	55		A
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ °C}$ )	--	2500	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	95	33	W
$t_{scw}$	Short circuit withstand time, $V_{CE} = 0.5V_{(BR)CES}$ , $T_C = 125\text{ °C}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	5		$\mu\text{s}$
$T_j$	Operating junction temperature	- 40 to 175		$^{\circ}\text{C}$

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2.  $V_{clamp} = 80\%$  of  $V_{CES}$ ,  $T_j = 175\text{ °C}$ ,  $R_G = 10\ \Omega$ ,  $V_{GE} = 15\text{ V}$

3. Pulse width limited by max. junction temperature allowed

**Table 3. Thermal resistance**

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case IGBT max.	1.56	4.5	$^{\circ}\text{C/W}$
$R_{thj-case}$	Thermal resistance junction-case diode max.	2.2	5.6	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max.	62.5		$^{\circ}\text{C/W}$

## 2 Electrical characteristics

( $T_{CASE}=25\text{ °C}$  unless otherwise specified)

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE}=0$ )	$I_C=1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}=15\text{ V}$ , $I_C=7\text{ A}$ $V_{GE}=15\text{ V}$ , $I_C=7\text{ A}$ , $T_C=125\text{ °C}$		2.1 1.8		V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}$ , $I_C=250\text{ }\mu\text{A}$	4.5		6.5	V
$I_{GES}$	Gate-emitter leakage current ( $V_{CE}=0$ )	$V_{GE}=\pm 20\text{ V}$ , $T_C=125\text{ °C}$			$\pm 100$	nA
$I_{CES}$	Collector cut-off current ( $V_{GE}=0$ )	$V_{CE}=600\text{ V}$ $V_{CE}=600\text{ V}$ , $T_C=125\text{ °C}$			150 1	$\mu\text{A}$ mA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE}=15\text{ V}$ , $I_C=7\text{ A}$		3.2		S

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE}=25\text{ V}$ , $f=1\text{ MHz}$ , $V_{GE}=0$		TBD		pF
$C_{oes}$	Output capacitance			TBD		pF
$C_{res}$	Reverse transfer capacitance			TBD		pF
$Q_g$	Total gate charge	$V_{CE}=390\text{ V}$ , $I_C=7\text{ A}$ , $V_{GE}=15\text{ V}$ (see Figure 3)		TBD		nC
$Q_{ge}$	Gate-emitter charge			TBD		nC
$Q_{gc}$	Gate-collector charge			TBD		nC

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , (see Figure 2)		TBD TBD TBD		ns ns A/ $\mu$ s
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$ (see Figure 2)		TBD TBD TBD		ns ns A/ $\mu$ s
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_{GE} = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see Figure 2)		TBD TBD TBD		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_{GE} = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 2)		TBD TBD TBD		ns ns ns

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , (see Figure 2)		TBD TBD TBD		$\mu$ J $\mu$ J $\mu$ J
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$ (see Figure 2)		TBD TBD TBD		$\mu$ J $\mu$ J $\mu$ J

- $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and DIODE are at the same temperature (25°C and 125°C)
- Turn-off losses include also the tail of the collector current.

**Table 8. Collector-emitter diode**

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$V_F$	Forward on-voltage	$I_F = 7\text{ A}$ $I_F = 7\text{ A}$ , $T_C = 125\text{ }^\circ\text{C}$		1.8 1.3	2.1	V V
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 7\text{ A}$ , $V_R = 40\text{ V}$ , $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 5)		37 40 2.1		ns nC A
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 7\text{ A}$ , $V_R = 40\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$ , $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 5)		61 98 3.2		ns nC A

### 3 Test circuit

Figure 2. Test circuit for inductive load switching

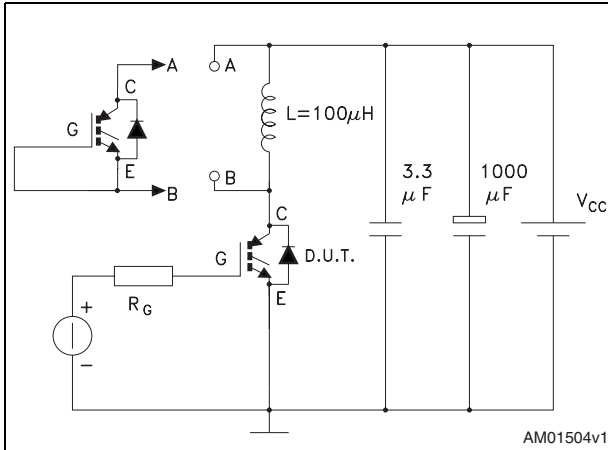


Figure 3. Gate charge test circuit

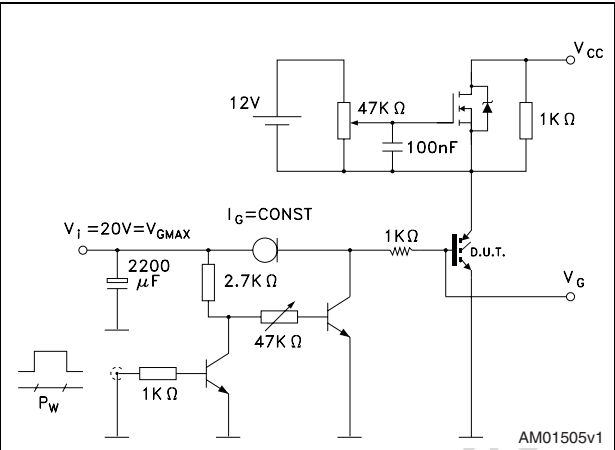


Figure 4. Switching waveforms

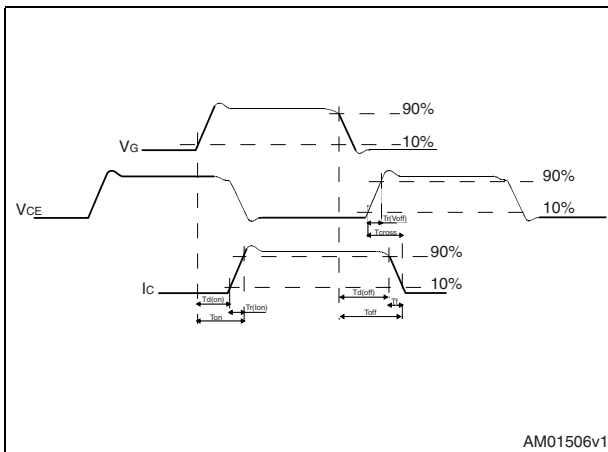
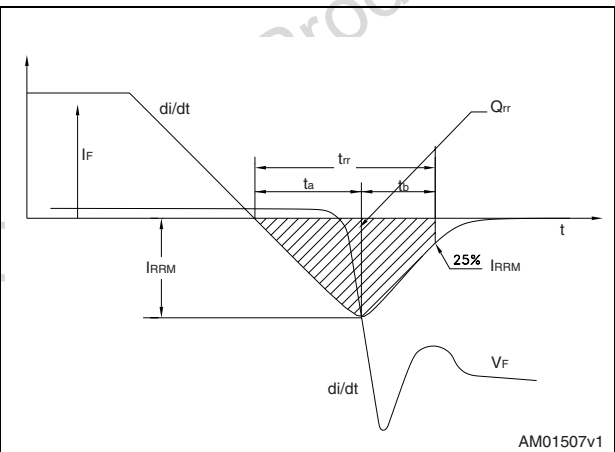


Figure 5. Diode recovery times waveform



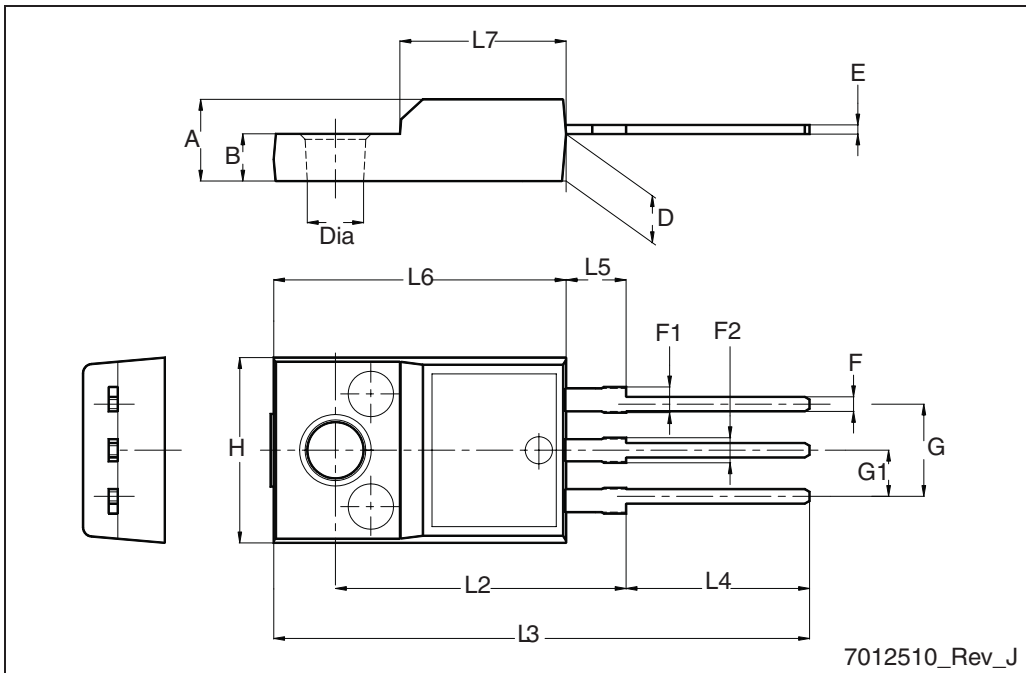
## 4 Package mechanical data

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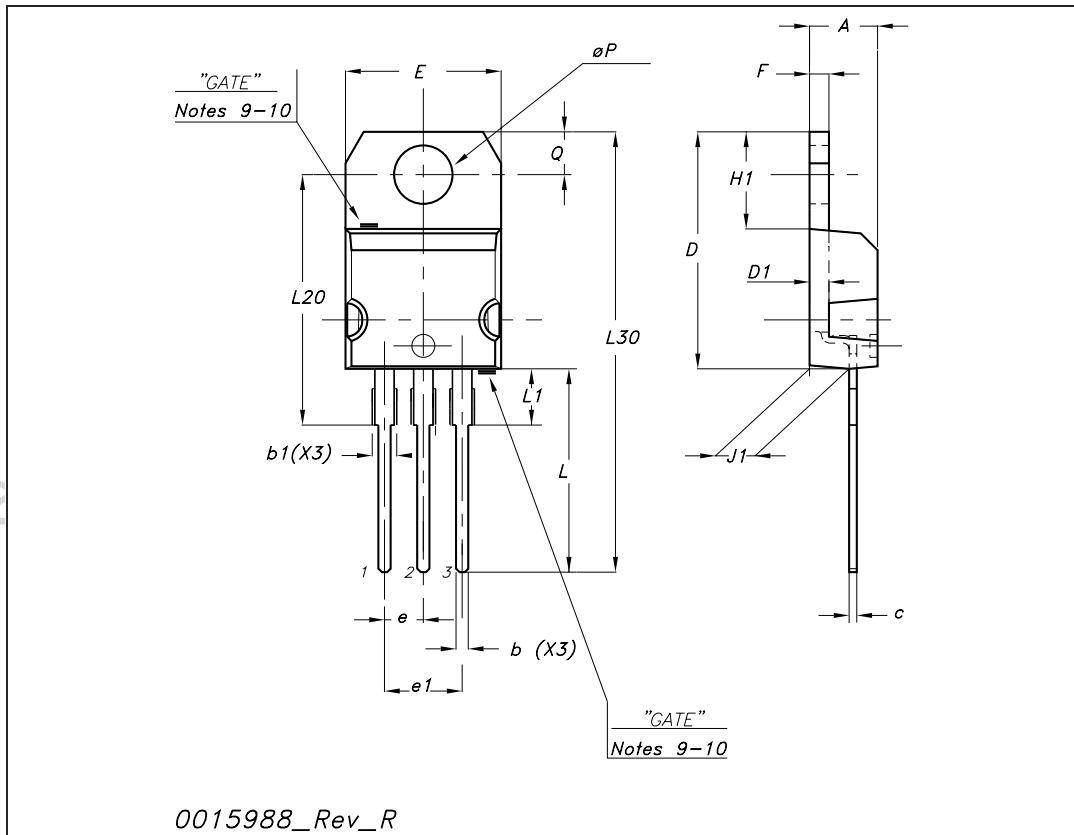
TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## 5 Revision history

Table 9. Document revision history

Date	Revision	Changes
20-Feb-2009	1	Initial release.

Obsolete Product(s) - Obsolete Product(s)

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