

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
- Ultrafast 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.

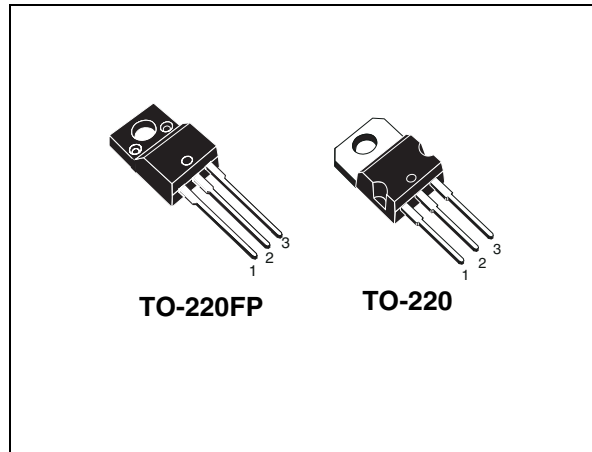


Figure 1. Internal schematic diagram

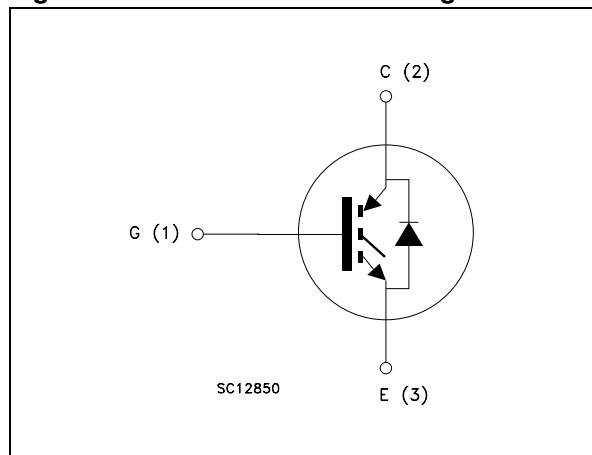


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGF14HF60KD	GF14HF60KD	TO-220FP	Tube
STGP14HF60KD	GP14HF60KD	TO-220	Tube

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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 °C	25	11	A
I _C ⁽¹⁾	Collector current (continuous) at T _C = 100 °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	±20		V
I _F	Diode RMS forward current at T _C = 25 °C	20		A
I _{FSM}	Surge non repetitive forward current t _p = 10 ms sinusoidal	55		A
V _{ISO}	Isolations withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T _C = 25 °C)	--	2500	V
P _{TOT}	Total dissipation at T _C = 25 °C	95	33	W
t _{scw}	Short-circuit withstand time, V _{CE} = 0.5V _{(BR)CES} , T _C = 125 °C, R _G = 10 Ω, V _{GE} = 12 V	5		μs
T _j	Operating junction temperature	– 40 to 175		°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 °C, R_G = 10 Ω, V_{GE} = 15 V

3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
R _{thj-case}	Thermal resistance junction-case IGBT	1.58	4.55	°C/W
R _{thj-case}	Thermal resistance junction-case diode	2.2	5.6	°C/W
R _{thj-amb}	Thermal resistance junction-ambient	62.5		°C/W

2 Electrical characteristics

($T_j = 25\text{ °C}$ 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	$V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$, $T_j = 150\text{ °C}$		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 ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$, $T_j = 150\text{ °C}$			± 100	nA
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_j = 150\text{ °C}$			150 1	μA mA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 7\text{ A}$		3		S

1. Pulsed: Pulse duration = 300 μs , 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	$V_{CE} = 390\text{ V}$, $I_C = 7\text{ A}$,	-	TBD	-	nC
Q_{ge}	Gate-emitter charge	$V_{GE} = 15\text{ V}$		TBD		nC
Q_{gc}	Gate-collector charge	(see Figure 3)		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	-	ns ns A/ μ s
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 2)	-	TBD	-	ns ns A/ μ 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	-	ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$, $R_{GE} = 10\ \Omega$, $V_{GE} = 15\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ (see Figure 2)	-	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	-	μ J μ J μ J
$E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 2)	-	TBD	-	μ J μ J μ 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	$I_F = 7\text{ A}$ $I_F = 7\text{ A}, T_j = 150\text{ °C}$	-	1.8	2.1	V
				1.2		V
t_{rr}	Reverse recovery time	$I_F = 7\text{ A}, V_R = 40\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 5)</i>	-	37		ns
Q_{rr}	Reverse recovery charge			40		nC
I_{rrm}	Reverse recovery current			2.2		A
t_{rr}	Reverse recovery time	$I_F = 7\text{ A}, V_R = 40\text{ V},$ $T_j = 150\text{ °C},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 5)</i>	-	123		ns
Q_{rr}	Reverse recovery charge			220		nC
I_{rrm}	Reverse recovery current			3.6		A

3 Test circuits

Figure 2. Test circuit for inductive load switching

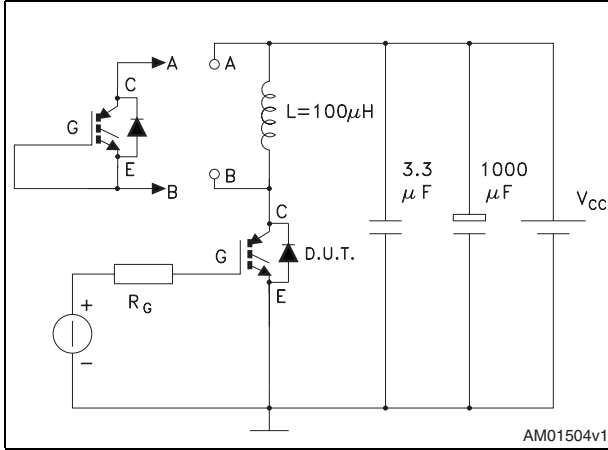


Figure 3. Gate charge test circuit

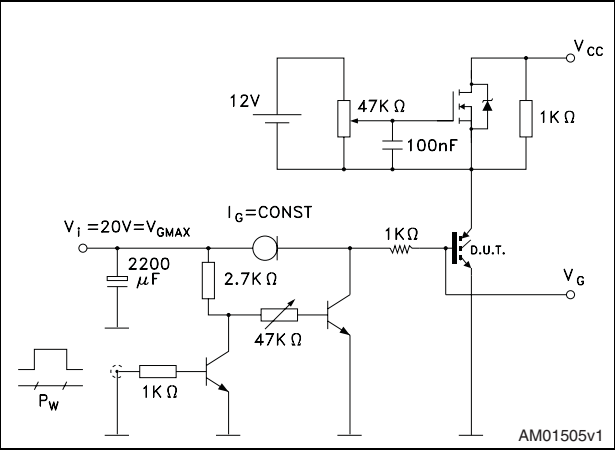


Figure 4. Switching waveforms

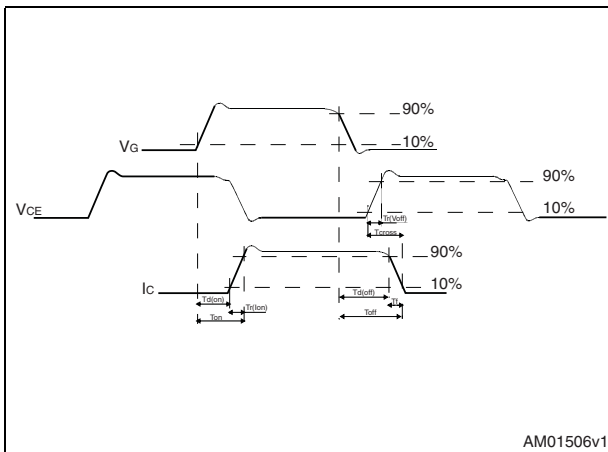
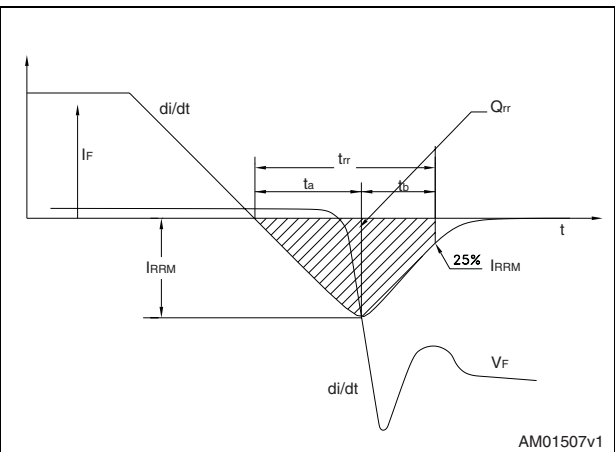


Figure 5. Diode recovery times waveform

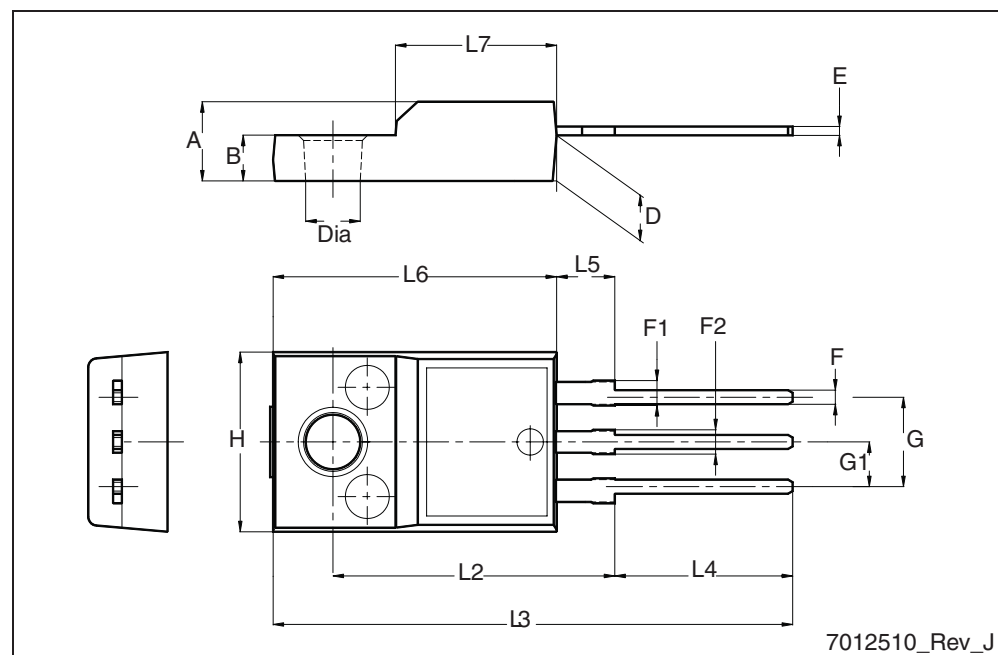


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

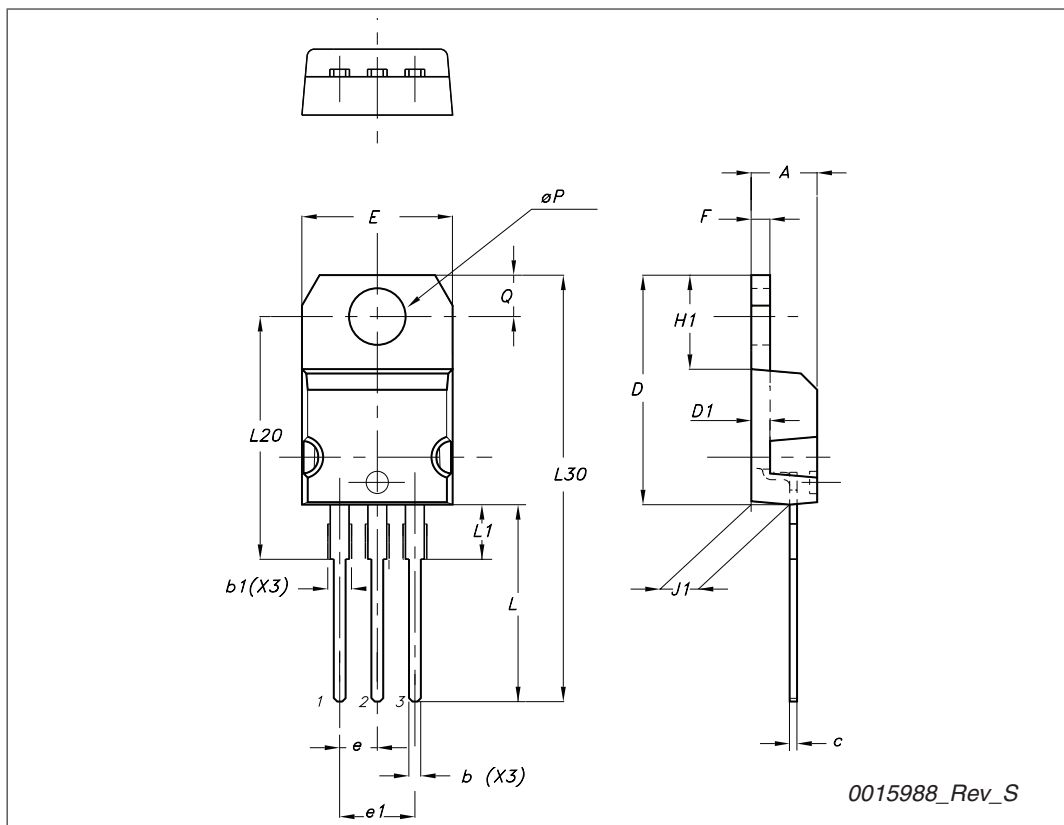
TO-220FP mechanical data

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 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
17-Aug-2009	1	Initial release.

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