

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.

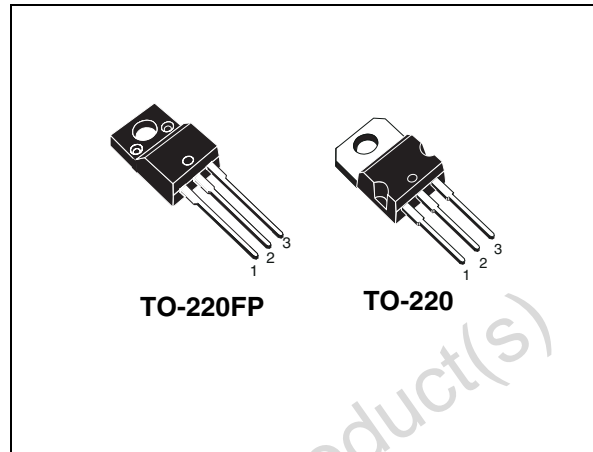


Figure 1. Internal schematic diagram

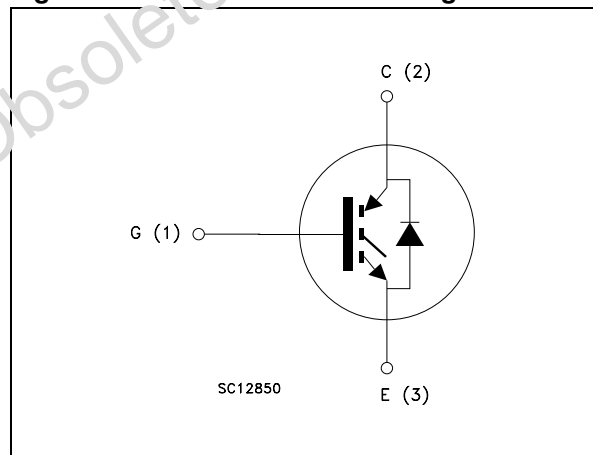


Table 1. Device summary

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

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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} | Insulation 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} = 15 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 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 | °C/W |
| R _{thj-case} | Thermal resistance junction-case diode max. | 2.2 | 5.6 | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient max. | 62.5 | | °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 ($V_{CE}=0$) | $V_{GE}=\pm 20\text{ V}$, $T_C=125\text{ °C}$ | | | ± 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 | μA mA |
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{CE}=15\text{ V}$, $I_C=7\text{ A}$ | | 3.2 | | 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 | $V_{CE}=390\text{ V}$, $I_C=7\text{ A}$, $V_{GE}=15\text{ V}$ (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/ μ s |
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 2) | | TBD TBD 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 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 | | 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 | $V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 2) | | TBD TBD 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 | $I_F = 7\text{ A}$ $I_F = 7\text{ A}$, $T_C = 125\text{ }^\circ\text{C}$ | | 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

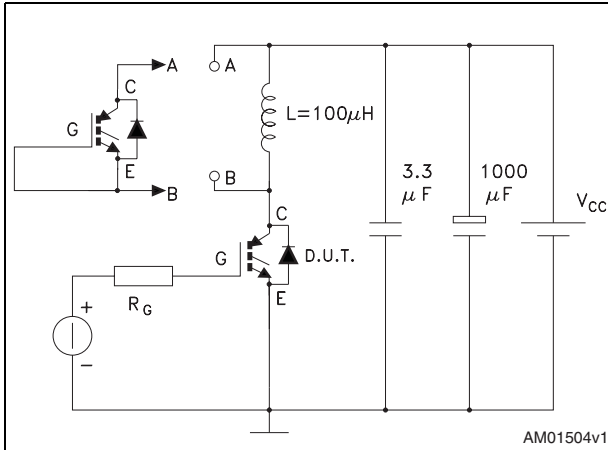


Figure 3. Gate charge test circuit

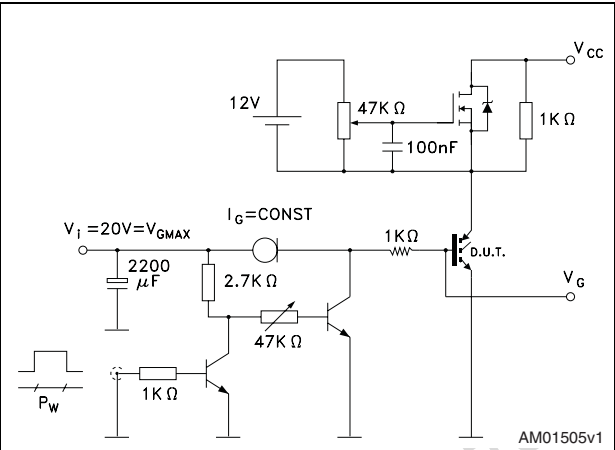


Figure 4. Switching waveforms

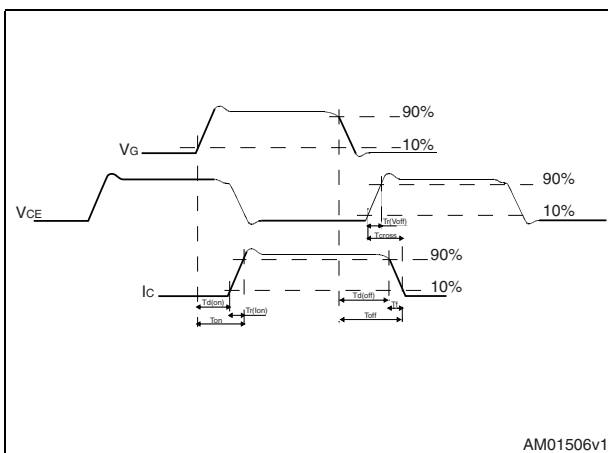
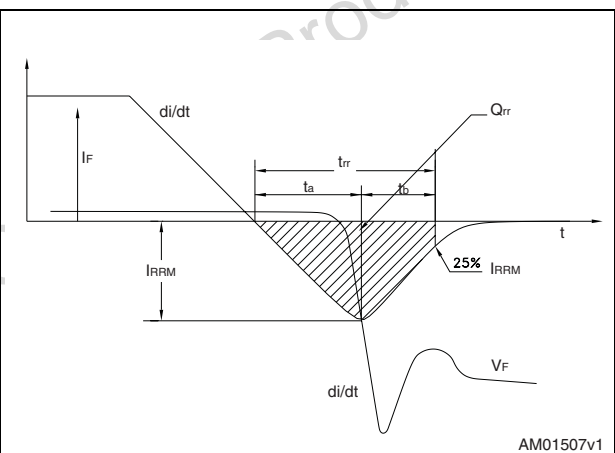


Figure 5. Diode recovery times waveform



Obsolete Product

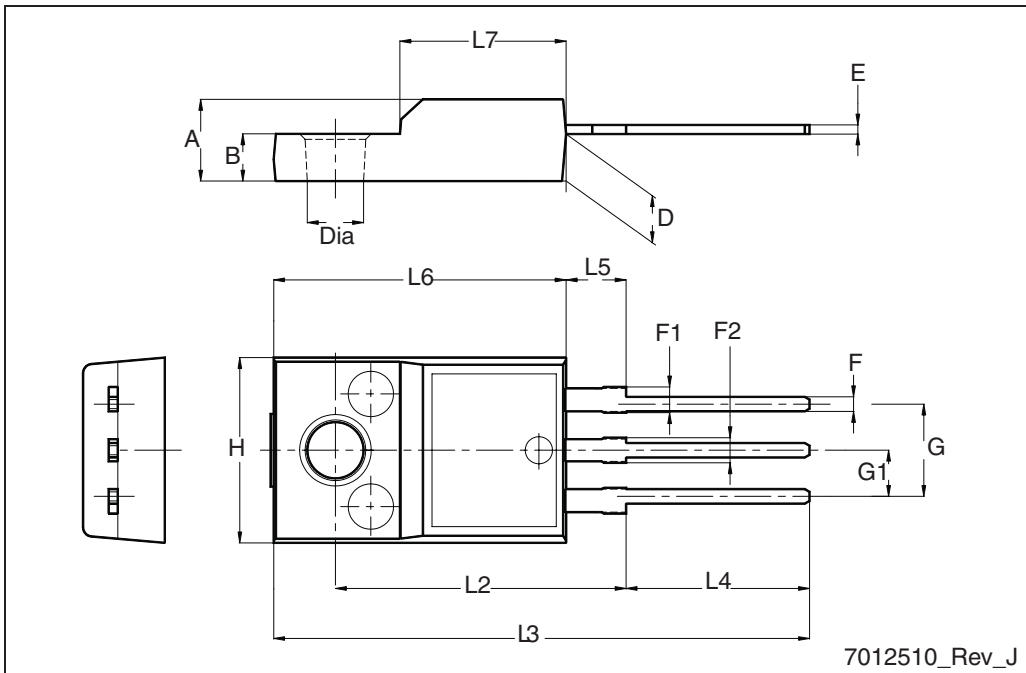
4 Package mechanical data

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.

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TO-220FP mechanical data

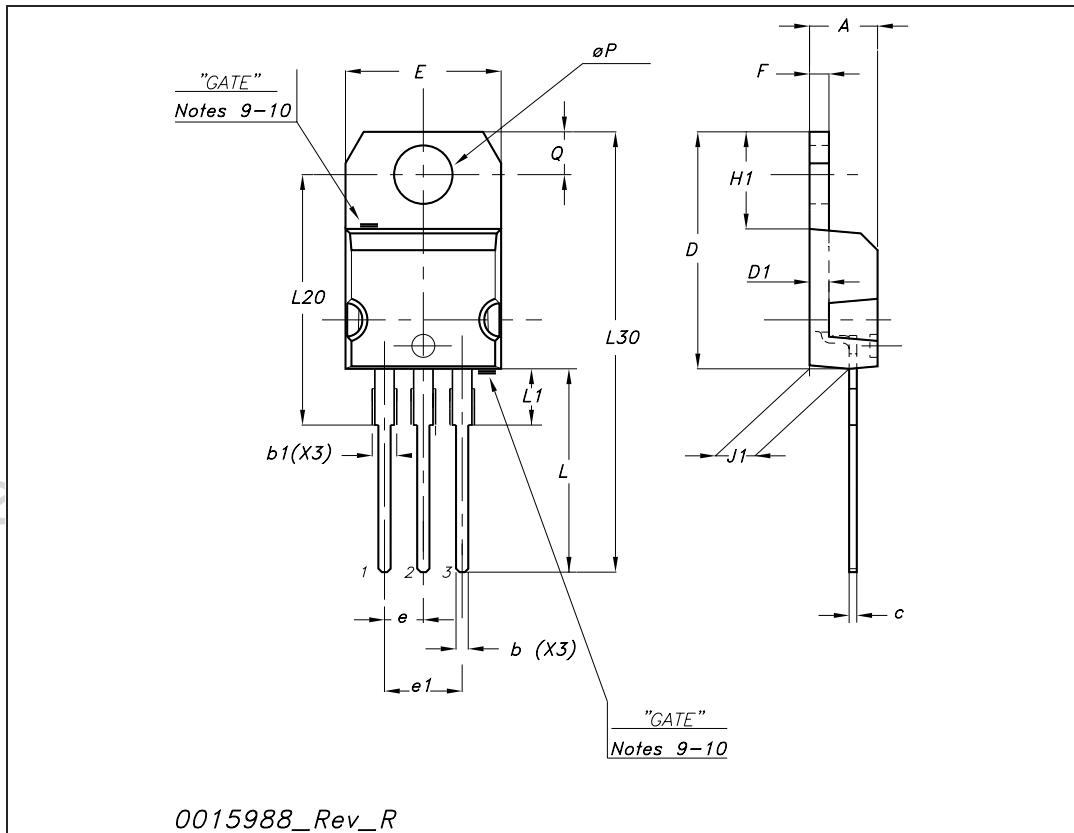
| Dim. | mm | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | 4.4 | | 4.6 |
| B | 2.5 | | 2.7 |
| D | 2.5 | | 2.75 |
| E | 0.45 | | 0.7 |
| F | 0.75 | | 1 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.5 |
| G | 4.95 | | 5.2 |
| G1 | 2.4 | | 2.7 |
| H | 10 | | 10.4 |
| L2 | | 16 | |
| L3 | 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 |



7012510_Rev_J

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. |

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