



**THE DATASHEET OF
STGW35HF60W**





STGF35HF60W, STGW35HF60W, STGFW35HF60W

35 A, 600 V Ultrafast IGBT

Datasheet – production data

Features

- Improved E_{off} at elevated temperature
- Minimal tail current
- Low conduction losses

Applications

- Welding
- High frequency converters
- Power factor correction

Description

This Ultrafast IGBT is developed using a new planar technology to yield a device with tighter switching energy variation (E_{off}) versus temperature. The suffix "W" denotes a subset of products designed for high switching frequency operation (over 100 kHz).

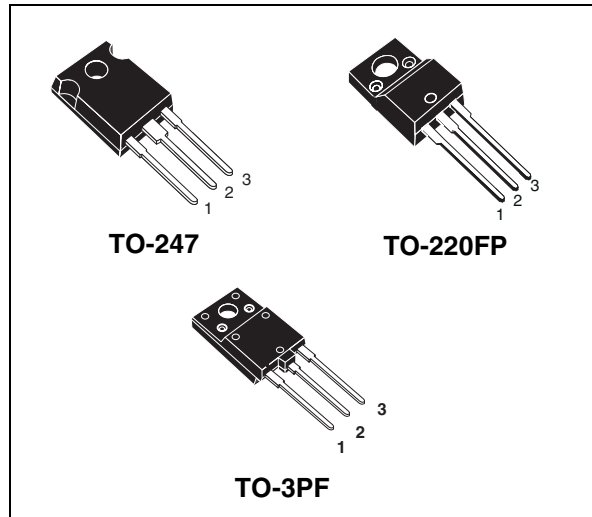


Figure 1. Internal schematic diagram

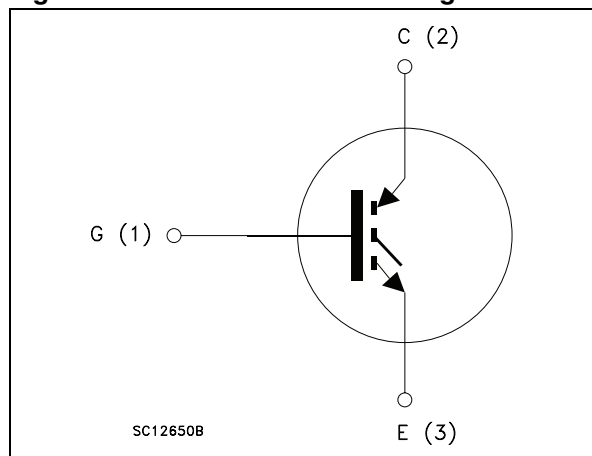


Table 1. Device summary

| Order codes | Markings | Packages | Packaging |
|--------------|-----------|----------|-----------|
| STGF35HF60W | GF35HF60W | TO-220FP | Tube |
| STGW35HF60W | GW35HF60W | TO-247 | |
| STGFW35HF60W | GF35HF60W | TO-3PF | |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | | Unit |
|----------------|---|-------------|----------|--------|------|
| | | TO-247 | TO-220FP | TO-3PF | |
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$) | 600 | | | V |
| I_C | Continuous collector current at $T_C = 25$ °C | 60 | 19 | 36 | A |
| I_C | Continuous collector current at $T_C = 100$ °C | 35 | 12 | 18 | A |
| $I_{CP}^{(1)}$ | Pulsed collector current | 150 | | | A |
| $I_{CL}^{(2)}$ | Turn-off latching current | 80 | | | A |
| V_{GE} | Gate-emitter voltage | ± 20 | | | V |
| 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 | 200 | 40 | 88 | W |
| T_{stg} | Storage temperature | - 55 to 150 | | | °C |
| T_J | Operating junction temperature | | | | |

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

2. $V_{CLAMP} = 80\%$ (V_{CES}), $V_{GE} = 15$ V, $R_G = 10$ Ω , $T_J = 150$ °C

Table 3. Thermal data

| Symbol | Parameter | Value | | | Unit |
|----------------|-------------------------------------|--------|----------|--------|------|
| | | TO-247 | TO-220FP | TO-3PF | |
| $R_{thj-case}$ | Thermal resistance junction-case | 0.63 | 3.1 | 1.41 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 50 | 62.5 | 50 | °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 | $V_{GE} = 15\text{ V}, I_C = 20\text{ A}$ | | 2 | 2.5 | V |
| | | $V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 125\text{ °C}$ | | 1.65 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}, I_C = 1\text{ mA}$ | 3.75 | | 5.75 | V |
| I_{CES} | Collector cut-off current ($V_{GE} = 0$) | $V_{CE} = 600\text{ V}$ | | | 250 | μA |
| | | $V_{CE} = 600\text{ V}, T_J = 125\text{ °C}$ | | | 1 | mA |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{ V}$ | | | ± 100 | nA |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|------------------------------|--|------|------|------|------|
| C_{ies} C_{oes} C_{res} | Input capacitance | $V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$ | - | 2400 | - | pF |
| | Output capacitance | | | 235 | | |
| | Reverse transfer capacitance | | | 50 | | |
| Q_g Q_{ge} Q_{gc} | Total gate charge | $V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $V_{GE} = 15\text{ V},$ (see Figure 18) | - | 140 | - | nC |
| | Gate-emitter charge | | | 13 | | nC |
| | Gate-collector charge | | | 52 | | 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 | $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 17) | - | 30 15 1650 | - | ns ns A/ μ s |
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see Figure 17) | - | 30 15 1600 | - | 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 | $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_{GE} = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17) | - | 30 175 40 | - | ns ns ns |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_{GE} = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see Figure 17) | - | 50 225 70 | - | ns ns ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|-------------------|------|-------------------------------|
| $E_{on}^{(1)}$ E_{off} E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 19) | - | 290 185 475 | | μ J μ J μ J |
| $E_{on}^{(1)}$ E_{off} E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see Figure 19) | - | 420 350 770 | 530 | μ J μ J μ J |

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in [Figure 19](#). If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C). E_{on} includes diode recovery energy.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

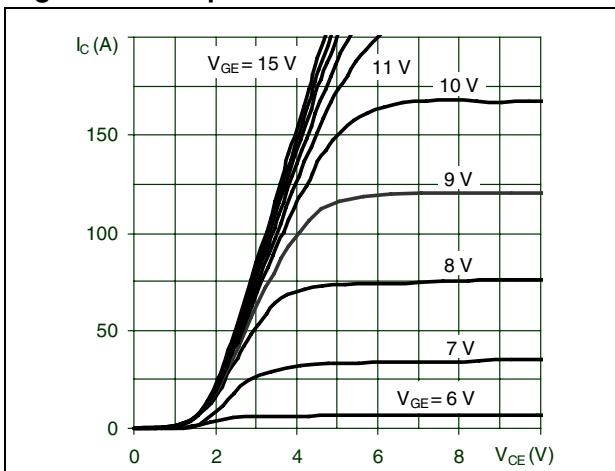


Figure 3. Transfer characteristics

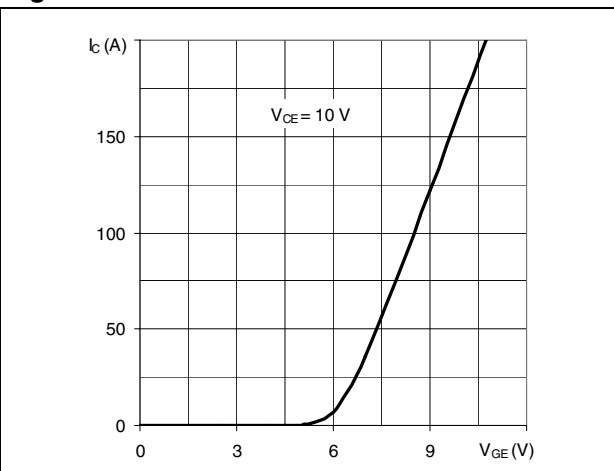


Figure 4. Normalized $V_{ce(sat)}$ vs. I_c

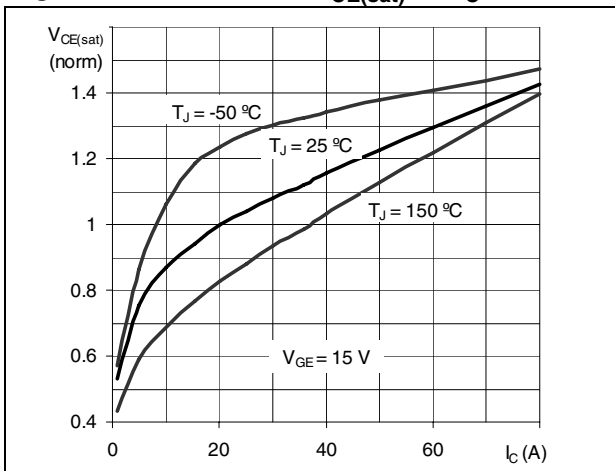


Figure 5. Normalized $V_{ce(sat)}$ vs. temperature

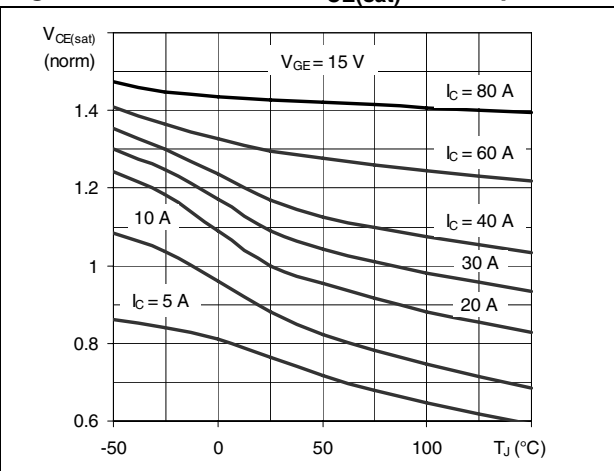


Figure 6. Normalized breakdown voltage vs. temperature

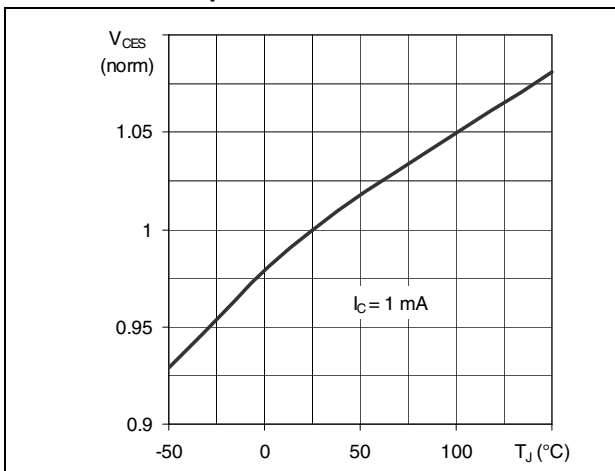


Figure 7. Normalized gate threshold voltage vs. temperature

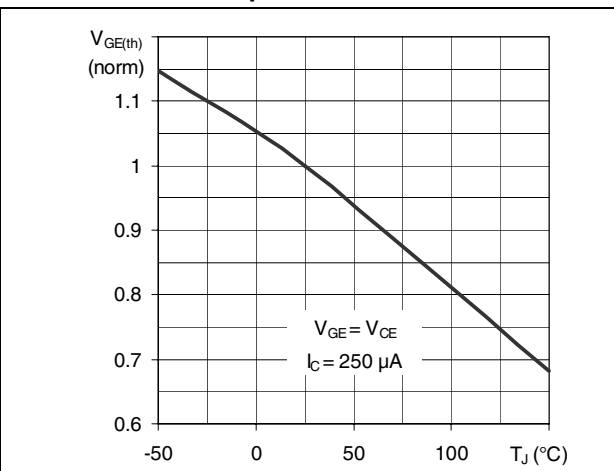


Figure 8. Gate charge vs. gate-emitter voltage

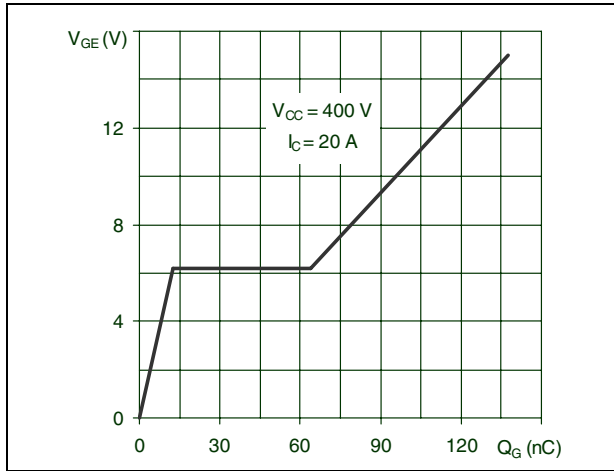


Figure 9. Capacitance variations

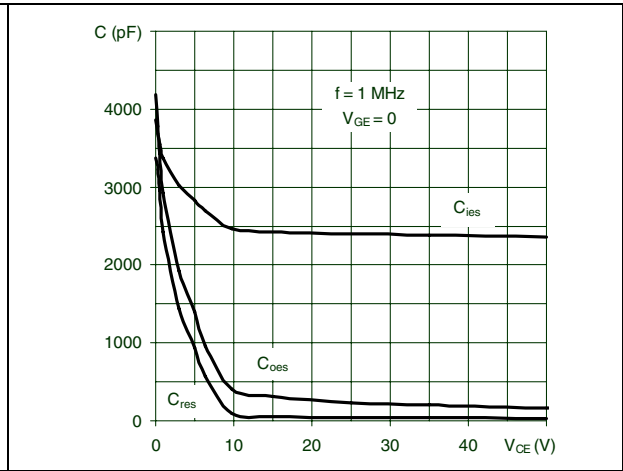


Figure 10. Switching losses vs. temperature

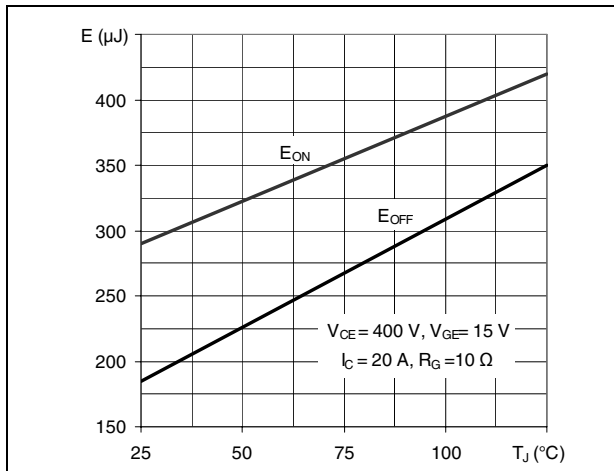


Figure 11. Switching losses vs. gate resistance

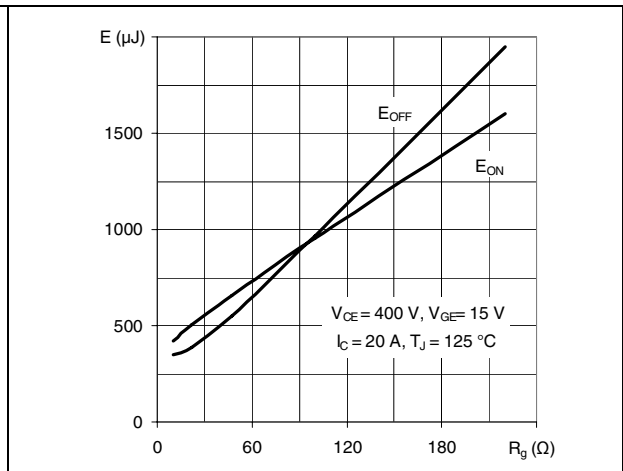


Figure 12. Switching losses vs. collector current

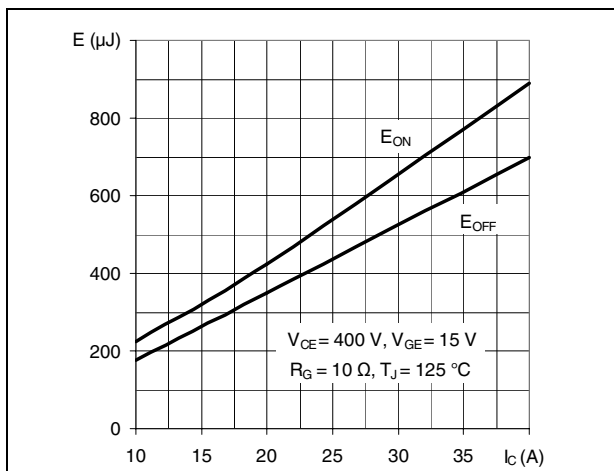


Figure 13. Turn-off SOA

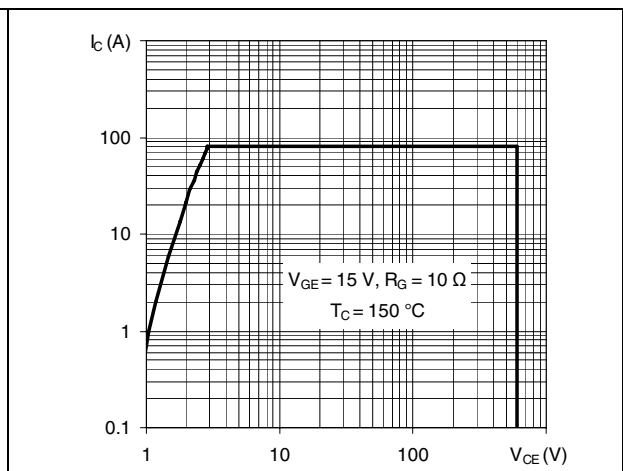


Figure 14. Thermal impedance for TO-247

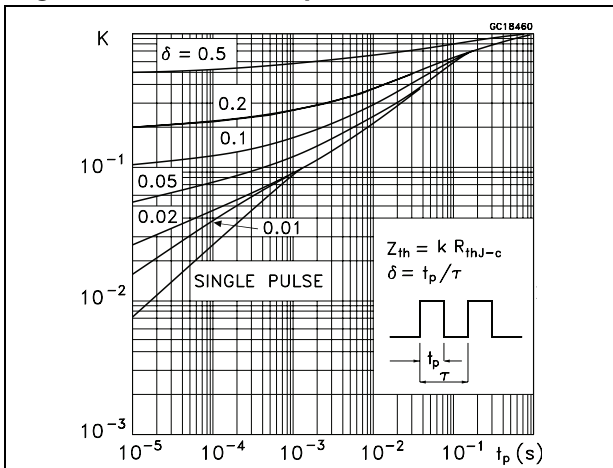


Figure 15. Thermal impedance for TO-220FP

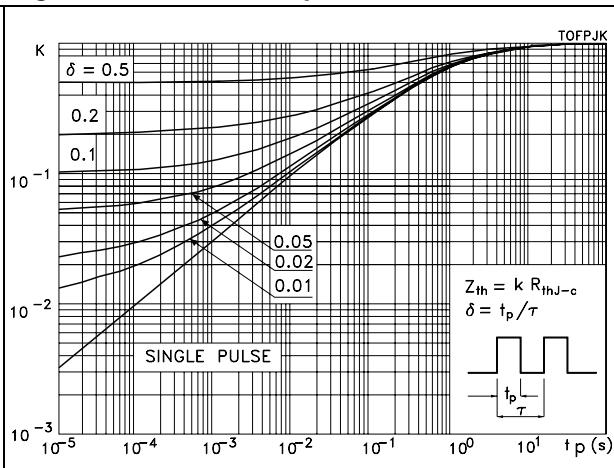
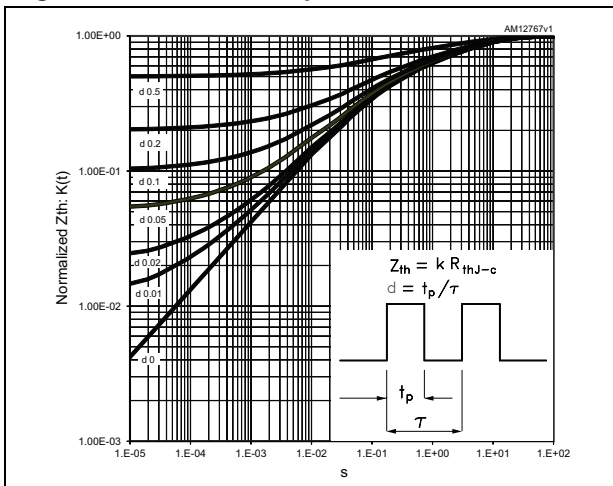


Figure 16. Thermal impedance for TO-3PF



3 Test circuits

Figure 17. Test circuit for inductive load switching

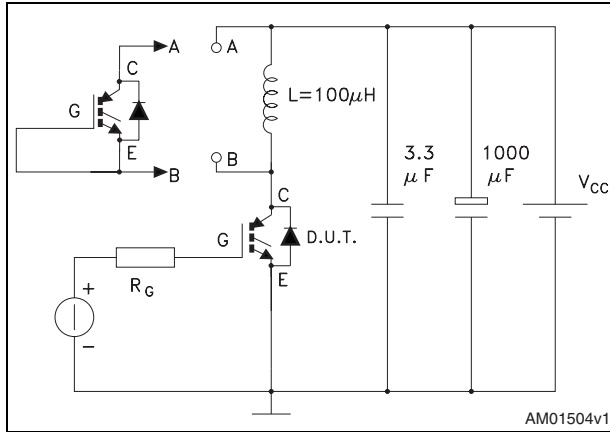


Figure 18. Gate charge test circuit

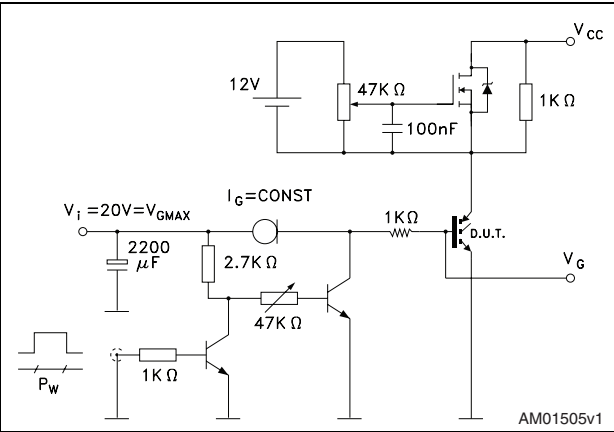
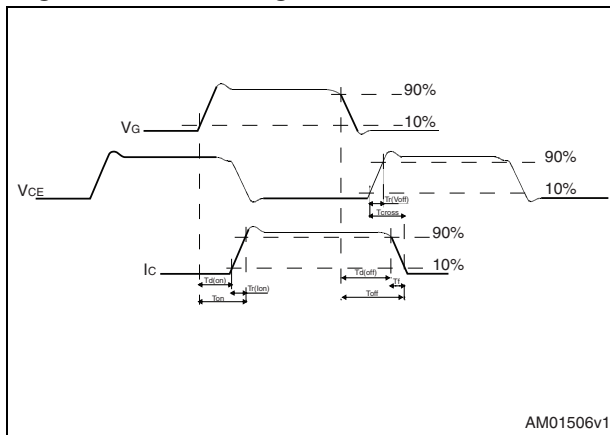


Figure 19. Switching waveform



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.

Table 8. 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 | | 1.70 |
| 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 |

Figure 20. TO-220FP drawing

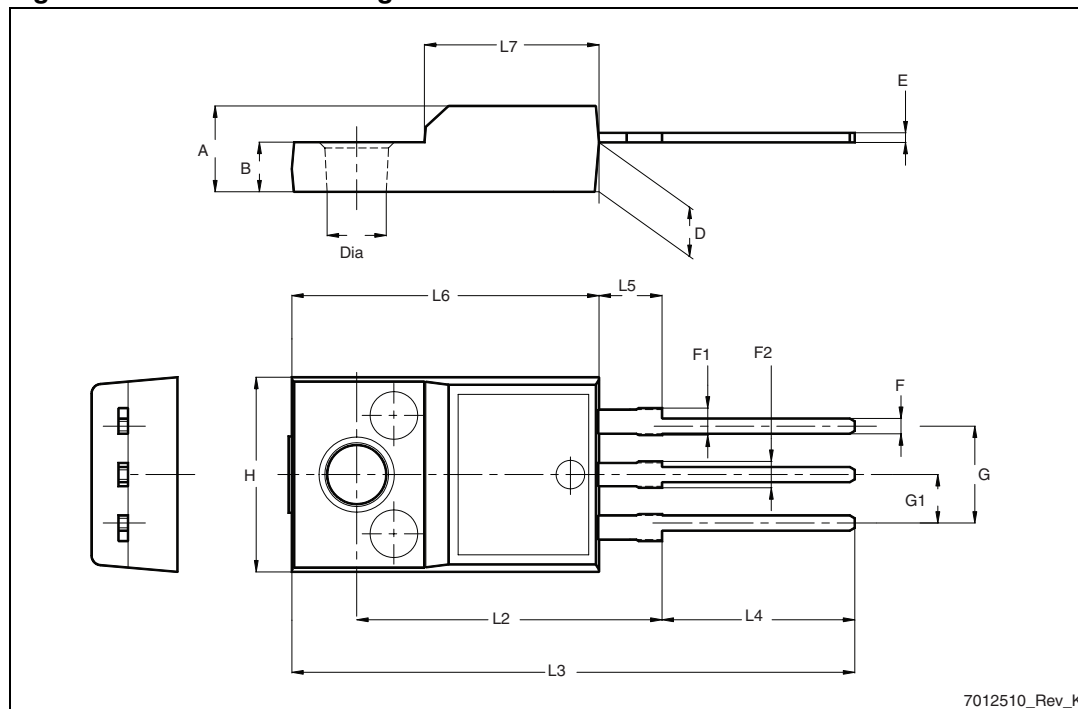


Table 9. TO-247 mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | | 5.45 | |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | | 5.50 | |

Figure 21. TO-247 drawing

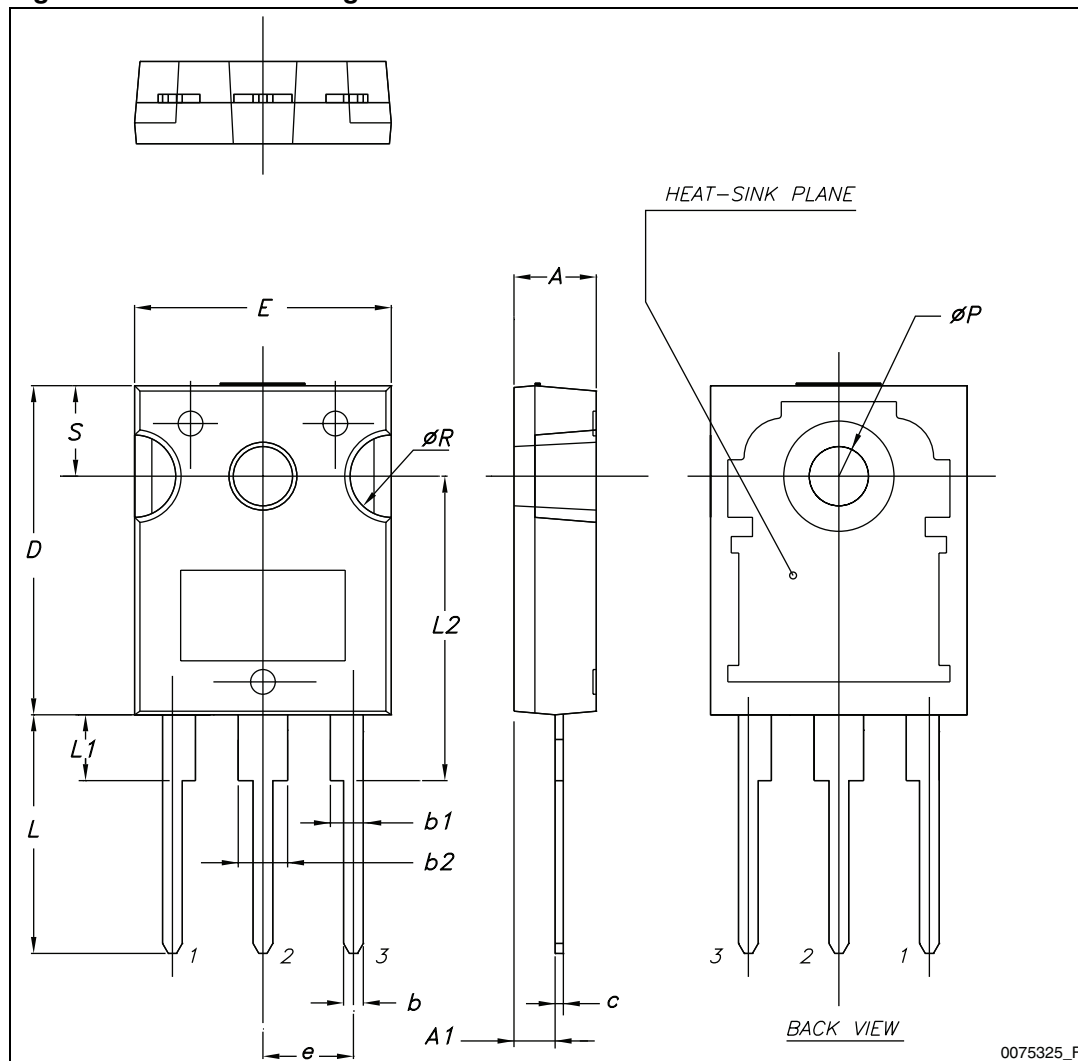
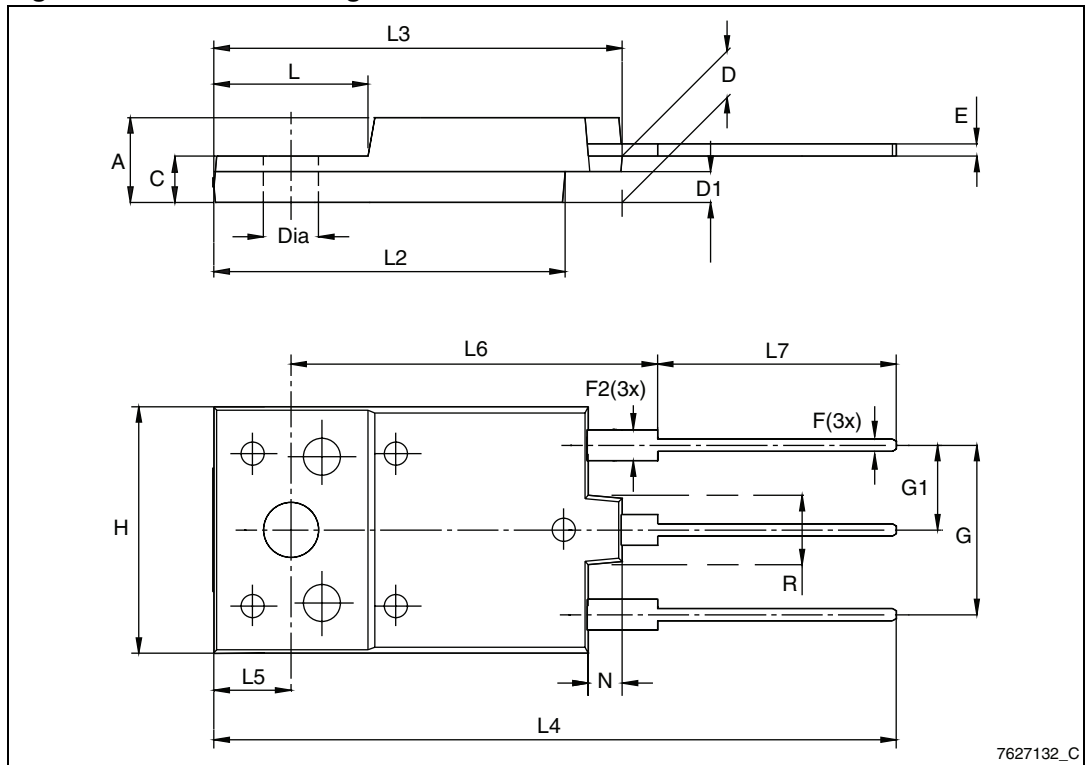


Table 10. TO-3PF mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 5.30 | | 5.70 |
| C | 2.80 | | 3.20 |
| D | 3.10 | | 3.50 |
| D1 | 1.80 | | 2.20 |
| E | 0.80 | | 1.10 |
| F | 0.65 | | 0.95 |
| F2 | 1.80 | | 2.20 |
| G | 10.30 | | 11.50 |
| G1 | | 5.45 | |
| H | 15.30 | | 15.70 |
| L | 9.80 | 10 | 10.20 |
| L2 | 22.80 | | 23.20 |
| L3 | 26.30 | | 26.70 |
| L4 | 43.20 | | 44.40 |
| L5 | 4.30 | | 4.70 |
| L6 | 24.30 | | 24.70 |
| L7 | 14.60 | | 15 |
| N | 1.80 | | 2.20 |
| R | 3.80 | | 4.20 |
| Dia | 3.40 | | 3.80 |

Figure 22. TO-3PF drawing



7627132_C

5 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|-----------------|--|
| 17-May-2010 | 1 | Initial release. |
| 14-Dec-2010 | 2 | Document status promoted from preliminary data to datasheet. Inserted new order code STGF35HF60W in TO-220FP package. |
| 24-Jul-2012 | 3 | Inserted new order code STGFW35HF60W in TO-3PF package. |

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