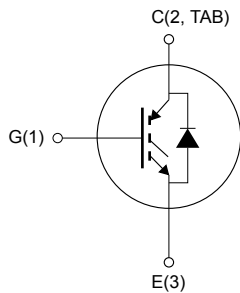
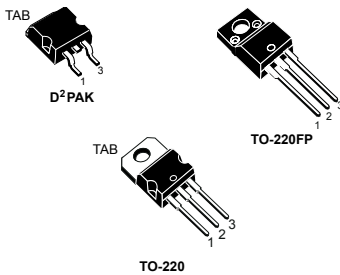


Trench gate field-stop 600 V, 10 A high speed H series IGBT



NG1E3C2T

Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Ultrafast soft recovery antiparallel diode

Applications

- Motor control
- UPS
- PFC

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the H series of IGBTs, which represents an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.



Product status link

[STGB10H60DF](#)
[STGF10H60DF](#)
[STGP10H60DF](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------|-------------------|------|
| | | D ² PAK, TO-220 | TO-220FP | |
| V _{CES} | Collector-emitter voltage (V _{GE} = 0 V) | 600 | | V |
| I _C | Continuous collector current at T _C = 25 °C | 20 | 20 ⁽¹⁾ | A |
| | Continuous collector current at T _C = 100 °C | 10 | 10 ⁽¹⁾ | |
| I _{CP} ⁽²⁾ | Pulsed collector current | 40 | 40 | A |
| V _{GE} | Gate-emitter voltage | ±20 | | V |
| | Transient gate-emitter voltage | ±30 | | |
| I _F | Continuous forward current T _C = 25 °C | 20 | 20 ⁽¹⁾ | A |
| | Continuous forward current at T _C = 100 °C | 10 | 10 ⁽¹⁾ | |
| I _{FP} ⁽²⁾ | Pulsed forward current | 40 | 40 | A |
| V _{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C) | | 2.5 | kV |
| P _{TOT} | Total power dissipation at T _C = 25 °C | 115 | 30 | W |
| T _{STG} | Storage temperature range | -55 to 150 | | °C |
| T _J | Operating junction temperature range | -55 to 175 | | |

1. Limited by maximum junction temperature.
2. Pulse width limited by maximum junction temperature.

Table 2. Thermal data

| Symbol | Parameter | Value | | Unit |
|-------------------|----------------------------------------|----------------------------|----------|------|
| | | D ² PAK, TO-220 | TO-220FP | |
| R _{thJC} | Thermal resistance junction-case IGBT | 1.3 | 5 | °C/W |
| R _{thJC} | Thermal resistance junction-case diode | 2.78 | 6.25 | °C/W |
| R _{thJA} | Thermal resistance junction-ambient | 62.5 | 62.5 | °C/W |

2 Electrical characteristics

$T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 3. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--------------------------------------|----------------------------------------------------------------------------------|------|------|-----------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage | $V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$ | 600 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}$, $I_C = 10\text{ A}$ | | 1.50 | 1.95 | V |
| | | $V_{GE} = 15\text{ V}$, $I_C = 10\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$ | | 1.65 | | |
| | | $V_{GE} = 15\text{ V}$, $I_C = 10\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$ | | 1.70 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$ | 5 | 6 | 7 | V |
| I_{CES} | Collector cut-off current | $V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$ | | | 25 | μA |
| I_{GES} | Gate-emitter leakage current | $V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$ | | | ± 250 | nA |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$ | - | 1300 | - | μF |
| C_{oes} | Output capacitance | | | 60 | | |
| C_{res} | Reverse transfer capacitance | | | 30 | | |
| Q_g | Total gate charge | $V_{CC} = 480\text{ V}$, $I_C = 10\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 33. Gate charge test circuit) | - | 57 | - | nC |
| Q_{ge} | Gate-emitter charge | | | 8 | | |
| Q_{gc} | Gate-collector charge | | | 27 | | |

Table 5. Switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|----------------------------------------------------------------------------------------------|------|------|------|---------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 10\text{ A}$, $R_G = 10\ \Omega$, | - | 19.5 | - | ns |
| t_r | Current rise time | $V_{GE} = 15\text{ V}$ | | 6.9 | | |
| $(di/dt)_{on}$ | Turn-on current slope | (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform) | | 1170 | | |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 10\text{ A}$, $R_G = 10\ \Omega$, | - | 20 | - | ns |
| t_r | Current rise time | $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$ | | 6.8 | | |
| $(di/dt)_{on}$ | Turn-on current slope | (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform) | | 1176 | | |
| $t_{r(voff)}$ | Off voltage rise time | $V_{CE} = 400\text{ V}$, $I_C = 10\text{ A}$, $R_G = 10\ \Omega$, | - | 19.6 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | $V_{GE} = 15\text{ V}$ | | 103 | | |
| t_f | Current fall time | (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform) | | 73 | | |
| $t_{r(voff)}$ | Off voltage rise time | $V_{CE} = 400\text{ V}$, $I_C = 10\text{ A}$, $R_G = 10\ \Omega$, | | 28 | | |
| $t_{d(off)}$ | Turn-off delay time | $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$ | | 104 | | |
| t_f | Current fall time | (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform) | 110 | | | |
| t_{sc} | Short-circuit withstand time | $V_{CC} \leq 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ | 3 | 5 | - | μ s |

Table 6. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------|
| $E_{on}^{(1)}$ | Turn-on switching energy | $V_{CE} = 400\text{ V}$, $I_C = 10\text{ A}$, | - | 83 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 32. Test circuit for inductive load switching) | | 140 | | |
| E_{ts} | Total switching energy | | | 223 | | |
| $E_{on}^{(1)}$ | Turn-on switching energy | $V_{CE} = 400\text{ V}$, $I_C = 10\text{ A}$, | | 148 | | |
| $E_{off}^{(2)}$ | Turn-off switching energy | $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$ (see Figure 32. Test circuit for inductive load switching) | | 214 | | |
| E_{ts} | Total switching energy | | | 362 | | |

1. Including the reverse recovery of the diode.

2. Including the tail of the collector current.

Table 7. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| V_F | Forward on-voltage | $I_F = 10\text{ A}$ | - | 1.7 | 2.2 | V |
| | | $I_F = 10\text{ A}, T_J = 175\text{ °C}$ | | 1.3 | | |
| t_{rr} | Reverse recovery time | $V_r = 60\text{ V}; I_F = 10\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$ (see Figure 35. Diode reverse recovery waveform) | - | 107 | | ns |
| Q_{rr} | Reverse recovery charge | | | 120 | | nC |
| I_{rrm} | Reverse recovery current | | | 2.24 | | A |
| t_{rr} | Reverse recovery time | $V_r = 60\text{ V}; I_F = 10\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$ $T_J = 175\text{ °C}$ (see Figure 35. Diode reverse recovery waveform) | - | 161 | | ns |
| Q_{rr} | Reverse recovery charge | | | 362 | | nC |
| I_{rrm} | Reverse recovery current | | | 4.5 | | A |

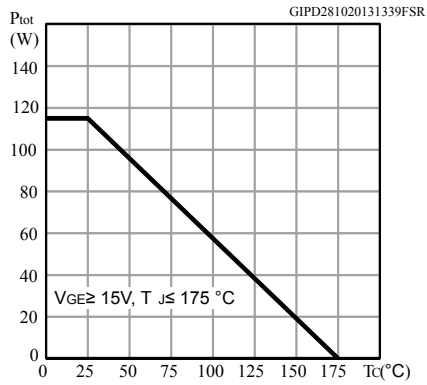
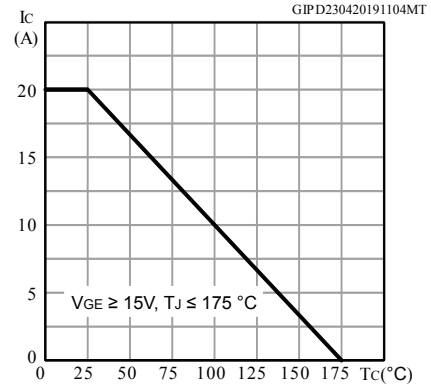
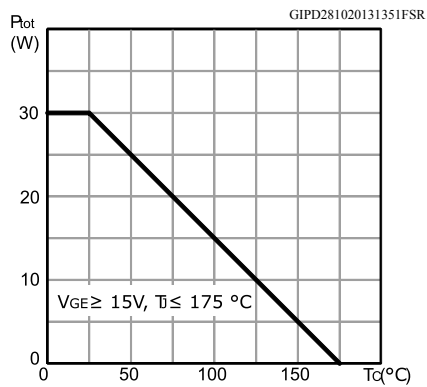
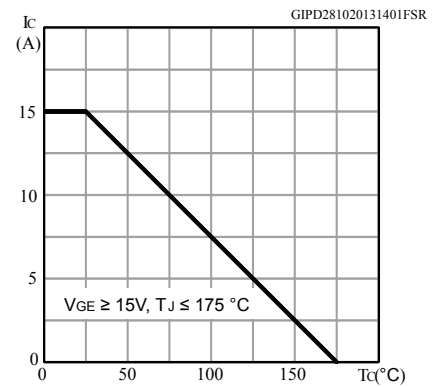
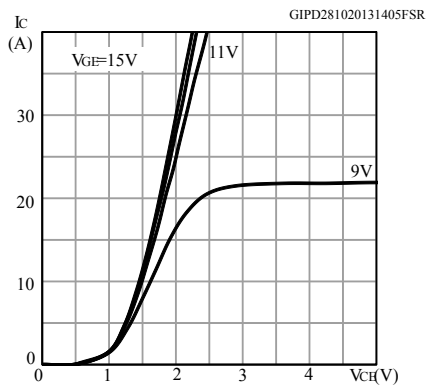
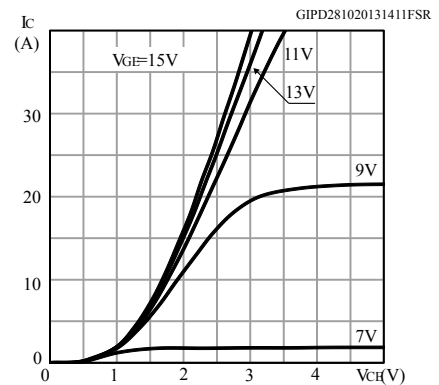
2.1 Electrical characteristics (curves)
Figure 1. Power dissipation vs case temperature for D²PAK and TO-220

Figure 2. Collector current vs case temperature for D²PAK and TO-220

Figure 3. Power dissipation vs case temperature for TO-220FP

Figure 4. Collector current vs case temperature for TO-220FP

Figure 5. Output characteristics (T_J = 25°C)

Figure 6. Output characteristics (T_J = 175°C)


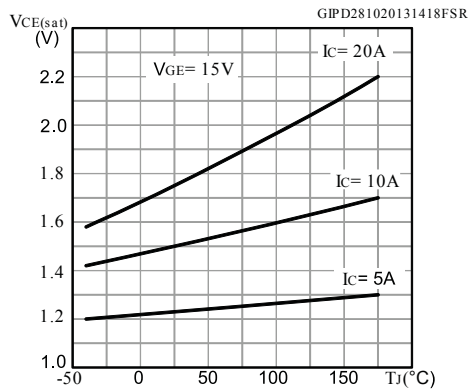
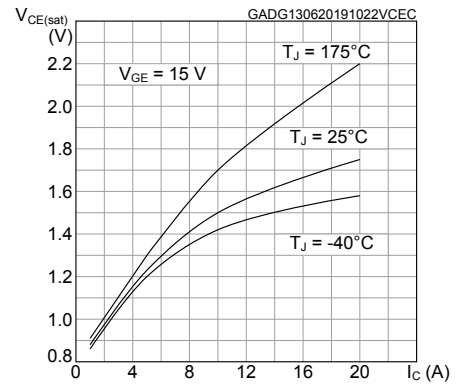
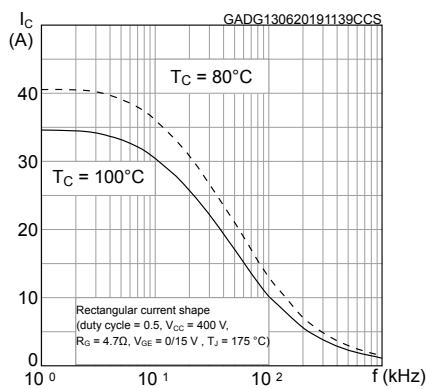
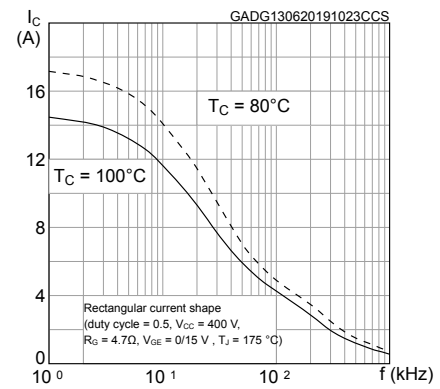
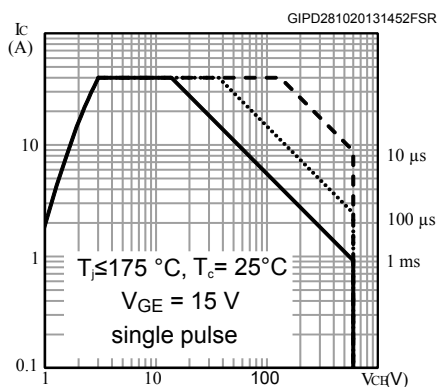
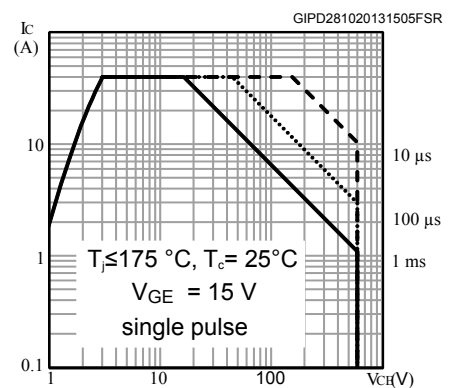
Figure 7. $V_{CE(sat)}$ vs junction temperature

Figure 8. $V_{CE(sat)}$ vs collector current

Figure 9. Collector current vs switching frequency for D²PAK and TO-220

Figure 10. Collector current vs switching frequency for TO-220FP

Figure 11. Forward bias safe operating area for D²PAK and TO-220

Figure 12. Forward bias safe operating area for TO-220FP


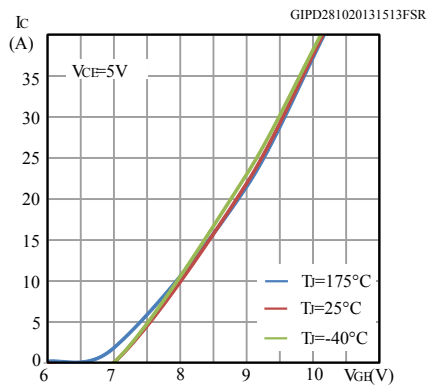
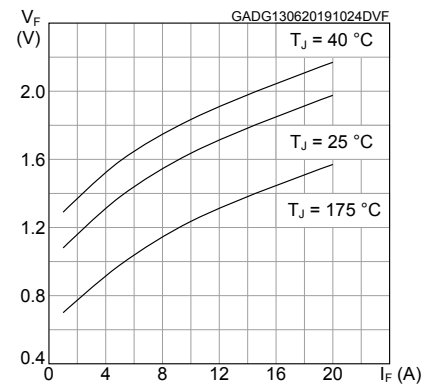
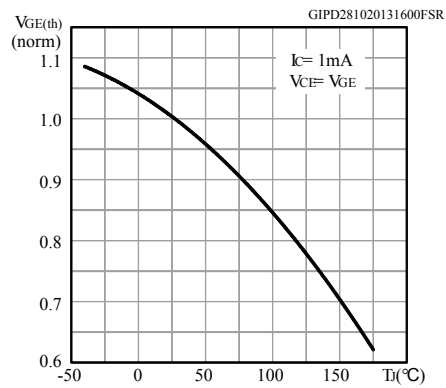
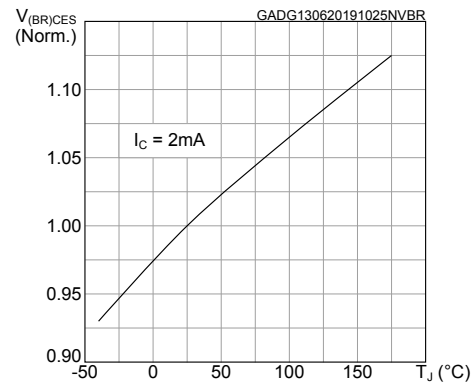
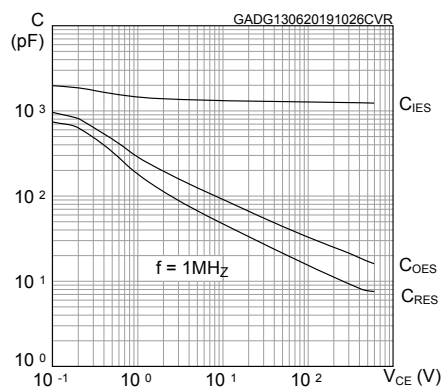
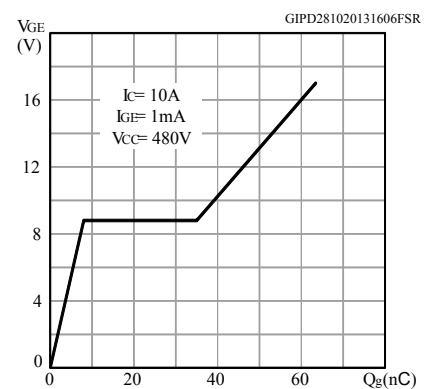
Figure 13. Transfer characteristics

Figure 14. Diode V_F vs forward current

Figure 15. Normalized $V_{GE(th)}$ vs junction temperature

Figure 16. Normalized $V_{(BR)CES}$ vs junction temperature

Figure 17. Capacitance variation

Figure 18. Gate charge vs gate-emitter voltage


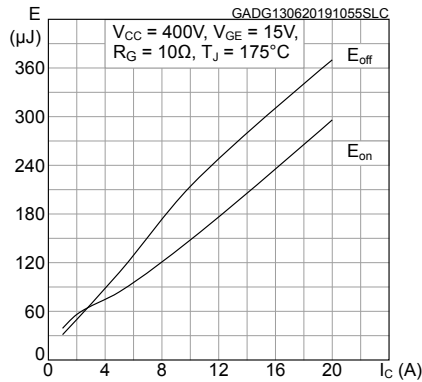
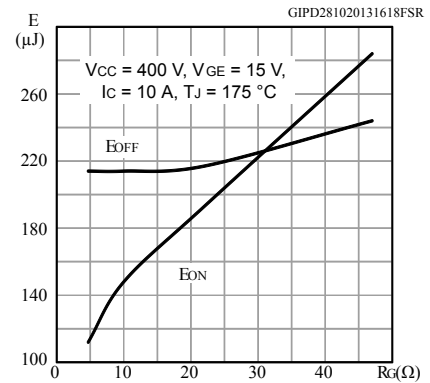
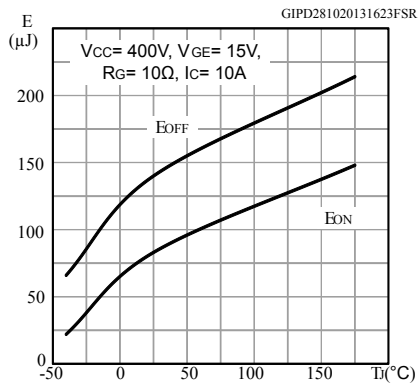
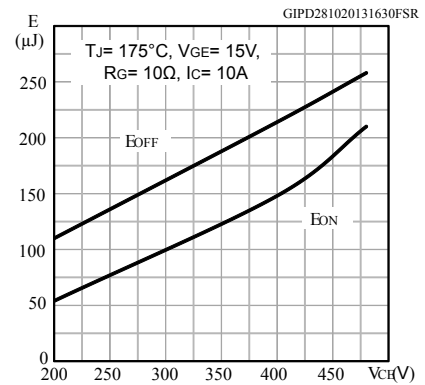
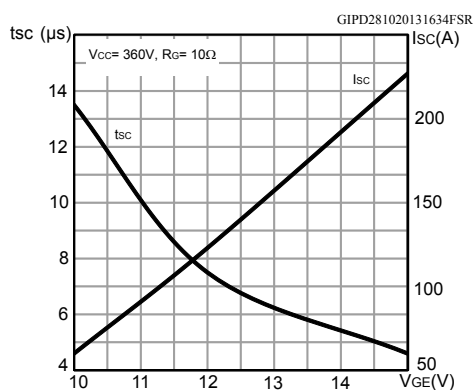
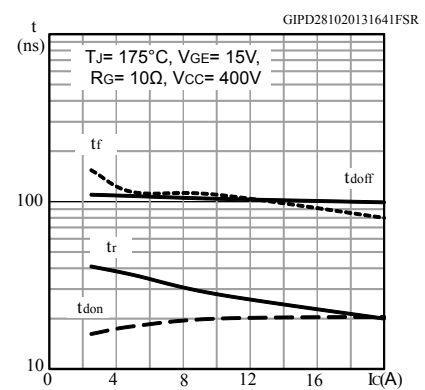
Figure 19. Switching energy vs collector current

Figure 20. Switching energy vs gate resistance

Figure 21. Switching energy vs temperature

Figure 22. Switching energy vs collector-emitter voltage

Figure 23. Short circuit time and current vs VGE

Figure 24. Switching times vs collector current


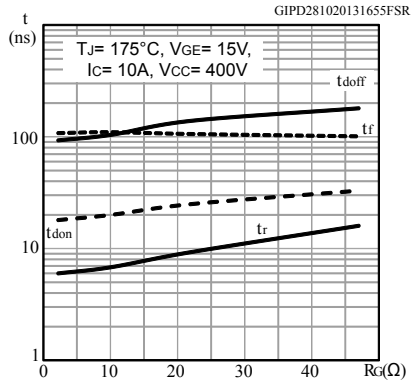
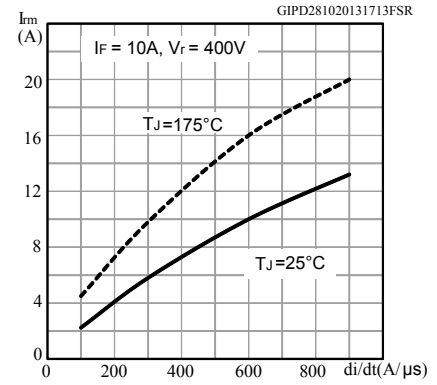
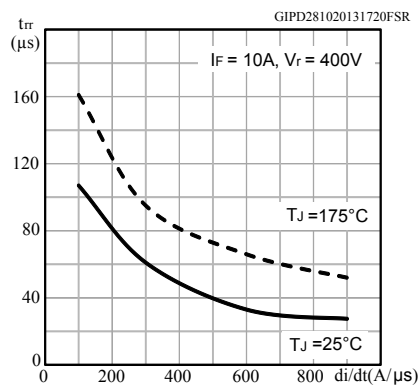
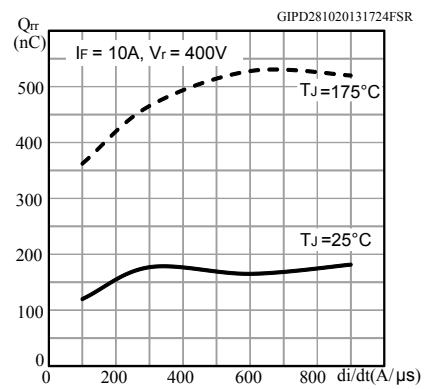
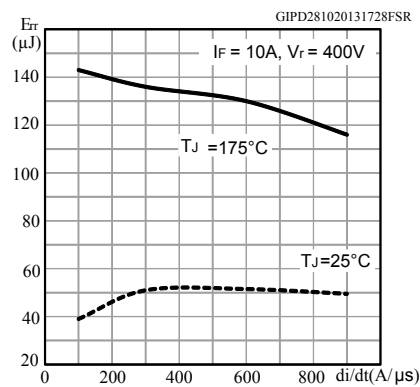
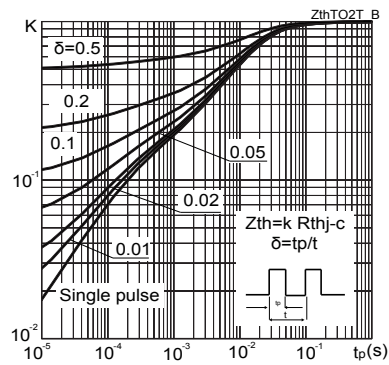
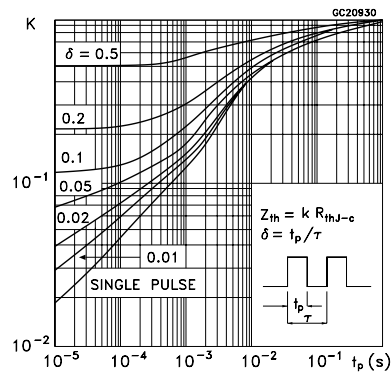
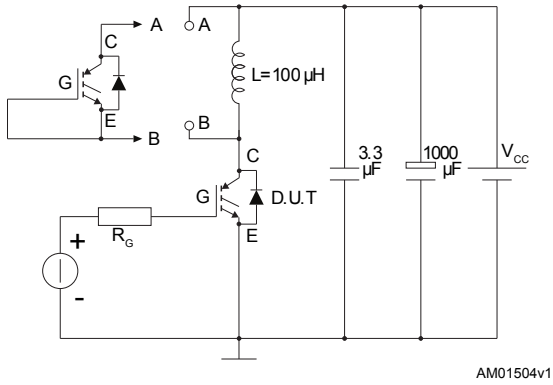
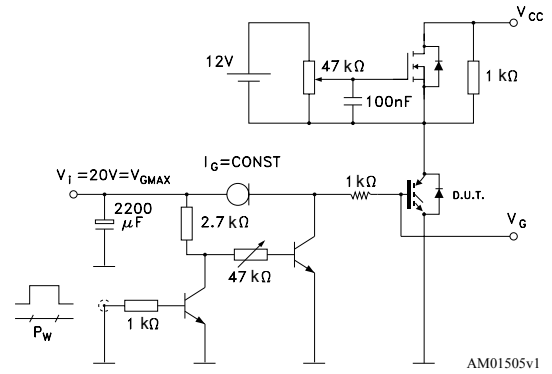
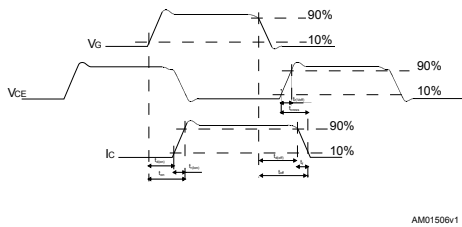
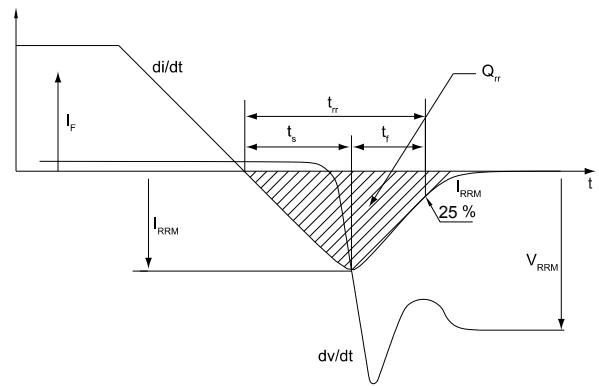
Figure 25. Switching times vs gate resistance

Figure 26. Reverse recovery current vs diode current slope

Figure 27. Reverse recovery time vs diode current slope

Figure 28. Reverse recovery charge vs diode current slope

Figure 29. Reverse recovery energy vs diode current slope


Figure 30. Thermal impedance for IGBT

Figure 31. Thermal impedance for diode


3 Test circuits

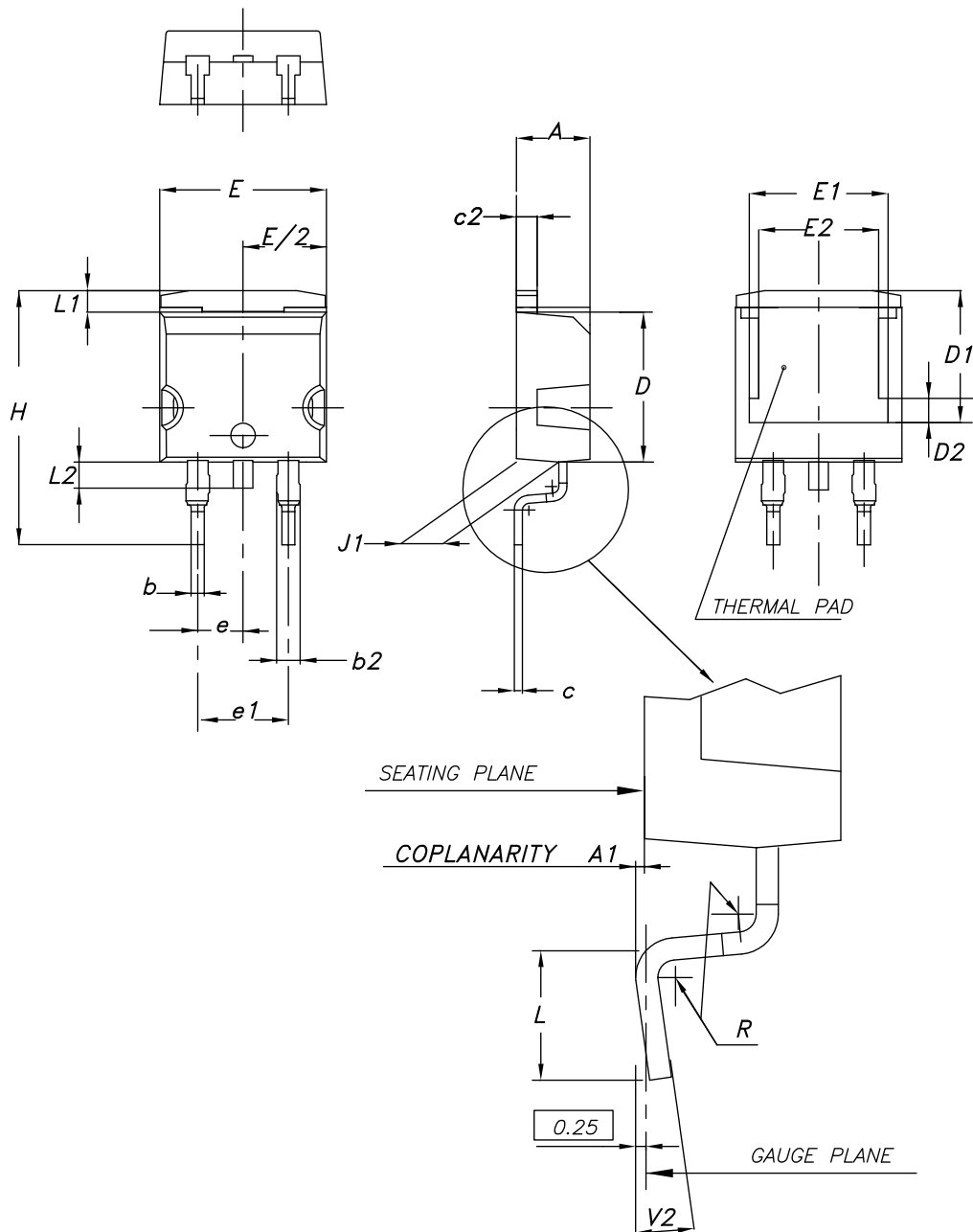
Figure 32. Test circuit for inductive load switching

Figure 33. Gate charge test circuit

Figure 34. Switching waveform

Figure 35. Diode reverse recovery waveform


4 Package information

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.

4.1 D²PAK (TO-263) type A2 package information

Figure 36. D²PAK (TO-263) type A2 package outline

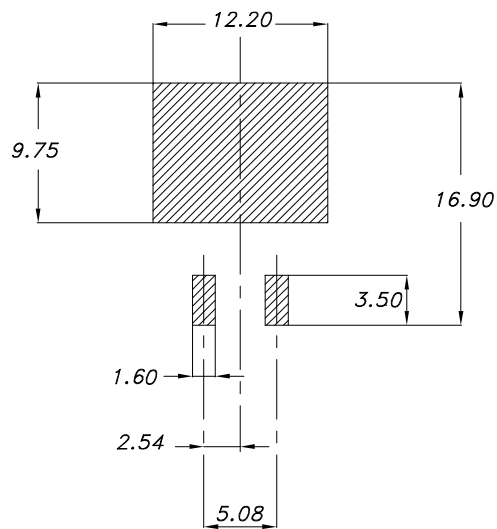


0079457_A2_26

Table 8. D²PAK (TO-263) type A2 package mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| A1 | 0.03 | | 0.23 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.45 | | 0.60 |
| c2 | 1.23 | | 1.36 |
| D | 8.95 | | 9.35 |
| D1 | 7.50 | 7.75 | 8.00 |
| D2 | 1.10 | 1.30 | 1.50 |
| E | 10.00 | | 10.40 |
| E1 | 8.70 | 8.90 | 9.10 |
| E2 | 7.30 | 7.50 | 7.70 |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15.00 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.40 | |
| V2 | 0° | | 8° |

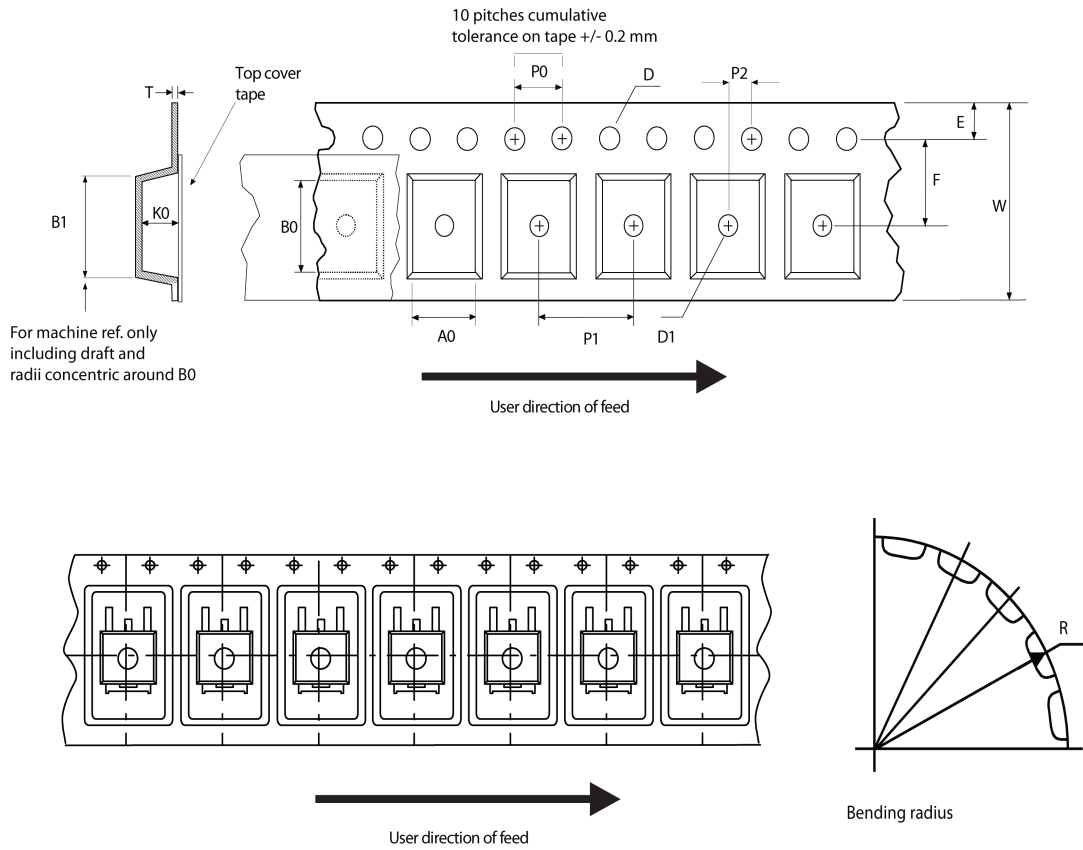
Figure 37. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint_26

4.2 D²PAK packing information

Figure 38. D²PAK tape outline



AM08852v1

Figure 39. D²PAK reel outline

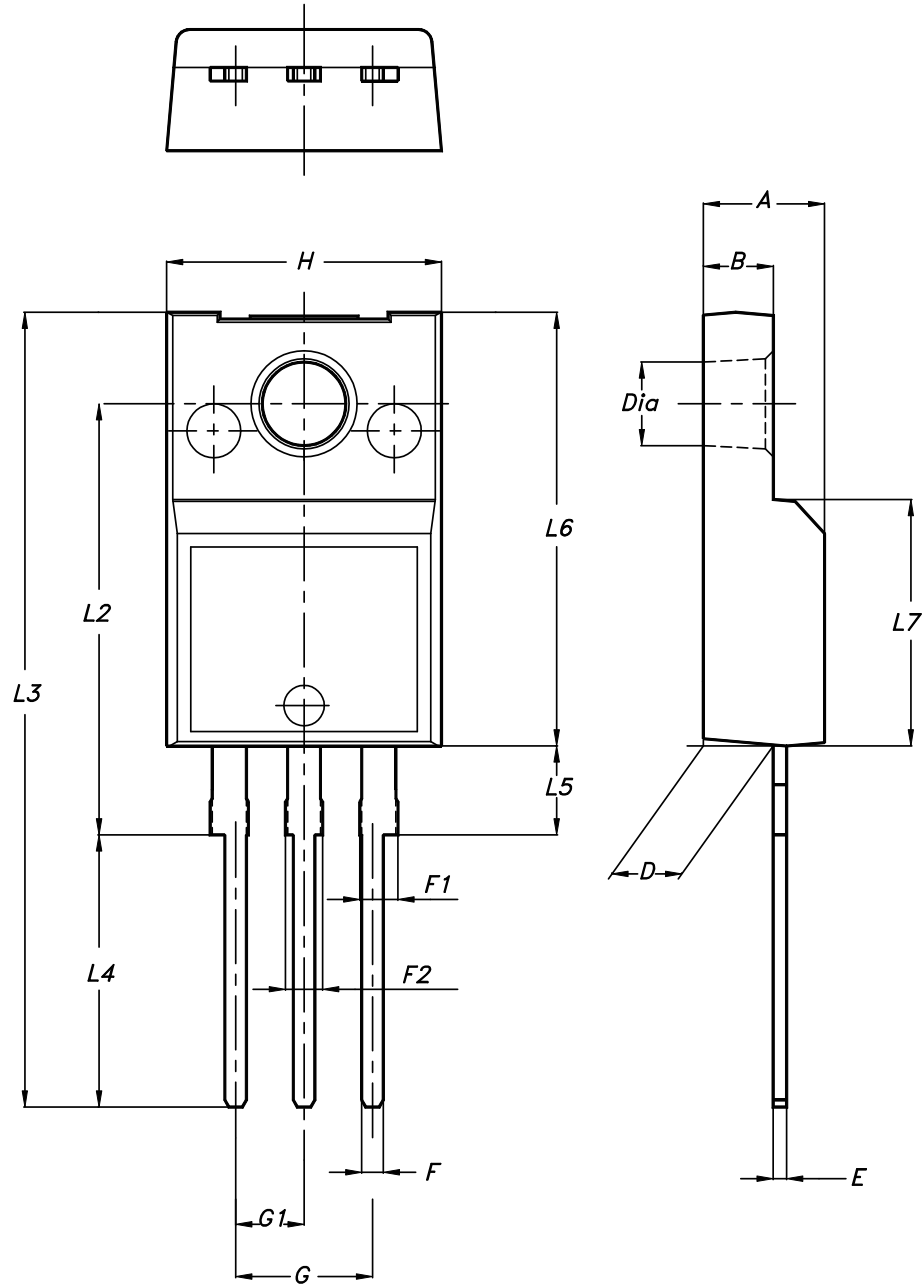

AM06038v1

Table 9. D²PAK tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|---------------|------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 10.5 | 10.7 | A | | 330 |
| B0 | 15.7 | 15.9 | B | 1.5 | |
| D | 1.5 | 1.6 | C | 12.8 | 13.2 |
| D1 | 1.59 | 1.61 | D | 20.2 | |
| E | 1.65 | 1.85 | G | 24.4 | 26.4 |
| F | 11.4 | 11.6 | N | 100 | |
| K0 | 4.8 | 5.0 | T | | 30.4 |
| P0 | 3.9 | 4.1 | | | |
| P1 | 11.9 | 12.1 | Base quantity | | 1000 |
| P2 | 1.9 | 2.1 | Bulk quantity | | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

4.3 TO-220FP package information

Figure 40. TO-220FP package outline



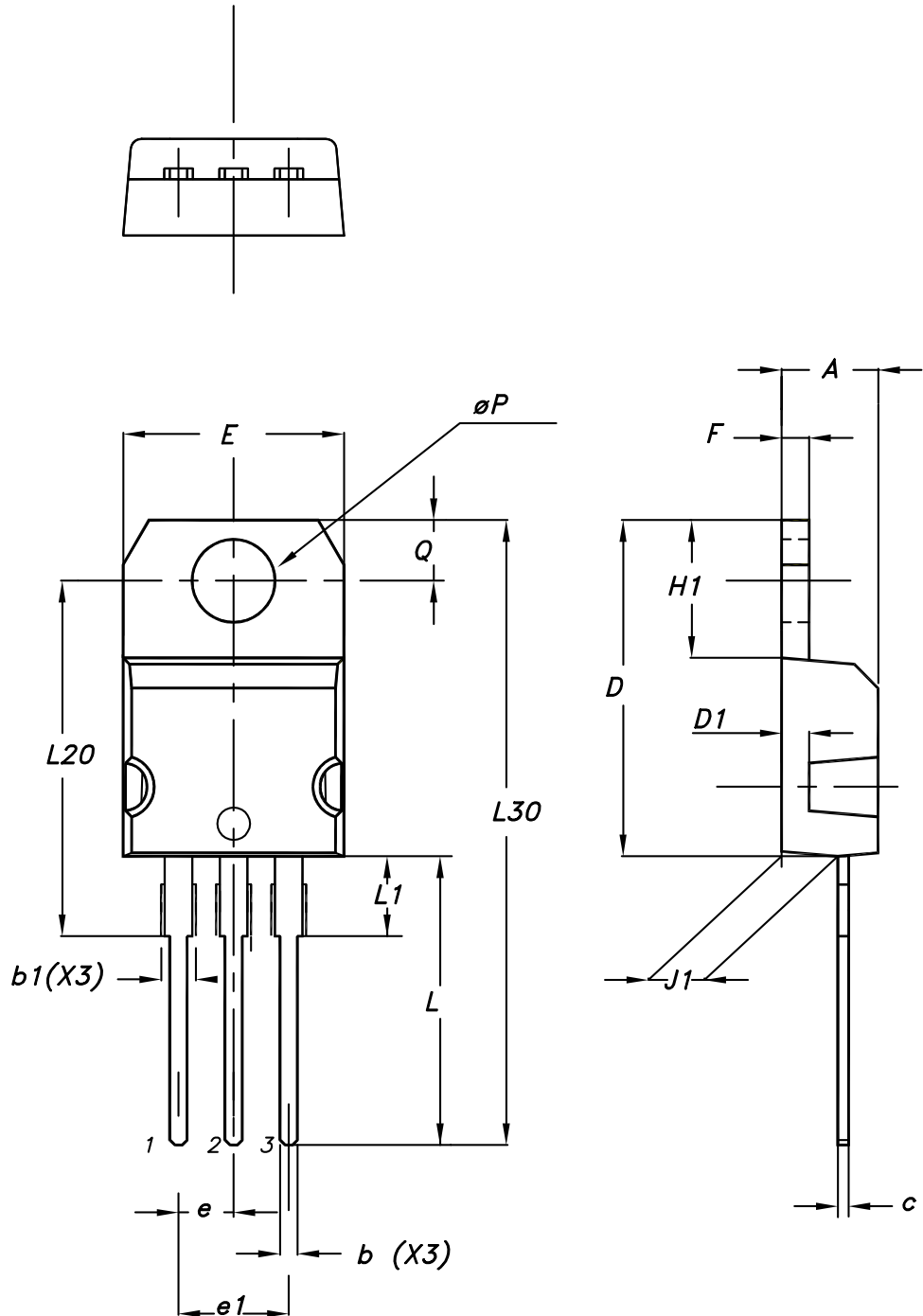
7012510_Rev_13_B

Table 10. TO-220FP package mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| B | 2.50 | | 2.70 |
| D | 2.50 | | 2.75 |
| E | 0.45 | | 0.70 |
| F | 0.75 | | 1.00 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.70 |
| G | 4.95 | | 5.20 |
| G1 | 2.40 | | 2.70 |
| H | 10.00 | | 10.40 |
| L2 | | 16.00 | |
| L3 | 28.60 | | 30.60 |
| L4 | 9.80 | | 10.60 |
| L5 | 2.90 | | 3.60 |
| L6 | 15.90 | | 16.40 |
| L7 | 9.00 | | 9.30 |
| Dia | 3.00 | | 3.20 |

4.4 TO-220 type A package information

Figure 41. TO-220 type A package outline



0015988_typeA_Rev_22

Table 11. TO-220 type A package mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.55 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10.00 | | 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 | 13.00 | | 14.00 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

5 Ordering information

Table 12. Order codes

| Order code | Marking | Package | Packing |
|-------------|-----------|--------------------|---------------|
| STGB10H60DF | GB10H60DF | D ² PAK | Tape and reel |
| STGF10H60DF | GF10H60DF | TO-220FP | Tube |
| STGP10H60DF | GP10H60DF | TO-220 | |

Revision history

Table 13. Document revision history

| Date | Version | Changes |
|-------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12-Aug-2013 | 1 | Initial release. |
| 31-Oct-2013 | 2 | Document status promoted from preliminary to production data. Inserted <i>Section 2.1: Electrical characteristics (curves)</i> . Minor text changes. |
| 20-Jun-2019 | 3 | Updated title, applications and description in cover page. Added <i>Section 5 Ordering information</i> . Updated <i>Section 2.1 Electrical characteristics (curves)</i> . Minor text changes. |
| 05-Mar-2020 | 4 | Updated Table 3. Static and Table 4. Dynamic . Minor text changes. |

Contents

| | | |
|------------|---------------------------------------------------------------|-----------|
| 1 | Electrical ratings | 2 |
| 2 | Electrical characteristics | 3 |
| 2.1 | Electrical characteristics (curves) | 6 |
| 3 | Test circuits | 12 |
| 4 | Package information | 13 |
| 4.1 | D ² PAK (TO-263) type A2 package information | 13 |
| 4.2 | D ² PAK packing information | 15 |
| 4.3 | TO-220FP package information | 17 |
| 4.4 | TO-220 type A package information | 19 |
| 5 | Ordering information | 21 |
| | Revision history | 22 |