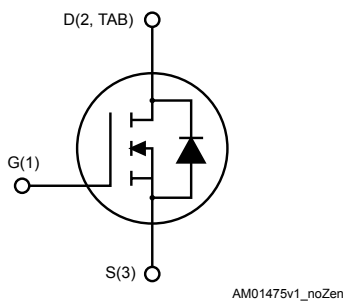


N-channel 250 V, 0.195 Ω typ., 14 A STripFET™ II Power MOSFETs in DPAK and TO-220FP packages



Features

| Order code | V_{DS} | $R_{DS(on)}$ max. | I_D | Package |
|------------|----------|-------------------|-------|----------|
| STD16NF25 | 250 V | 0.235 Ω | 14 A | DPAK |
| STF16NF25 | | | | TO-220FP |

- Exceptional dv/dt capability
- 100% avalanche tested
- Low gate charge

Applications

- Switching applications

Description

These Power MOSFETs have been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the devices suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.



Product status link

[STD16NF25](#)
[STF16NF25](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|-------------------------|---|------------|--------------------|------|
| | | DPAK | TO-220FP | |
| V_{DS} | Drain-source voltage | 250 | | V |
| V_{GS} | Gate-source voltage | ±20 | | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ °C}$ | 14 | 14 ⁽¹⁾ | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 8.8 | 8.8 ⁽¹⁾ | A |
| I_{DM} ⁽²⁾ | Drain current (pulsed) | 56 | 56 ⁽¹⁾ | A |
| P_{TOT} | Total power dissipation at $T_C = 25\text{ °C}$ | 85 | 25 | W |
| dv/dt ⁽³⁾ | Peak diode recovery voltage slope | 15 | | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ °C}$) | | 2.5 | kV |
| T_j | Operating junction temperature range | -55 to 150 | | °C |
| T_{stg} | Storage temperature range | | | |

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 13\text{ A}$, $di/dt \leq 300\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

Table 2. Thermal data

| Symbol | Parameter | Value | | Unit |
|------------------------------|-------------------------------------|-------|----------|------|
| | | DPAK | TO-220FP | |
| $R_{thj-case}$ | Thermal resistance junction-case | 1.47 | 5 | °C/W |
| $R_{thj-pcb}$ ⁽¹⁾ | Thermal resistance junction-pcb | 50 | | |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | | 62.5 | |

- When mounted on FR-4 board of 1 inch², 2 oz Cu.

Table 3. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|-------------------------|---|-------|------|
| I_{AR} ⁽¹⁾ | Avalanche current, repetitive or not-repetitive | 13 | A |
| E_{AS} ⁽²⁾ | Single pulse avalanche energy | 100 | mJ |

- Pulse width limited by T_{jmax} .
- Starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|---|------|-------|-----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$ | 250 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}$, $V_{DS} = 250\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 250\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾ | | | 10 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$ | | 0.195 | 0.235 | Ω |

1. Defined by design, not subject to production test.

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|-------------------------------|--|------|------|------|---------------|
| C_{iss} | Input capacitance | $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 680 | - | μF |
| C_{oss} | Output capacitance | | | 125 | | |
| C_{rss} | Reverse transfer capacitance | | | 20 | | |
| $C_{oss\text{ eq.}}$ ⁽¹⁾ | Equivalent output capacitance | $V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ V to } 200\text{ V}$ | - | 48 | - | μF |
| R_G | Gate input resistance | $f = 1\text{ MHz}$, $I_D = 0\text{ A}$ | - | 2.1 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 200\text{ V}$, $I_D = 13\text{ A}$, | - | 18 | - | nC |
| Q_{gs} | Gate-source charge | $V_{GS} = 0\text{ to } 10\text{ V}$ | | 3 | | |
| Q_{gd} | Gate-drain charge | (see Figure 16. Test circuit for gate charge behavior) | | 9 | | |

1. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS} .

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 125\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform) | - | 9 | - | ns |
| t_r | Rise time | | | 17 | | |
| $t_{d(off)}$ | Turn-off delay time | | | 35 | | |
| t_f | Fall time | | | 17 | | |

Table 7. Source-drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|------|
| I_{SD} | Source-drain current | | - | | 14 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 56 | |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 13\text{ A}$, $V_{GS} = 0\text{ V}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ | - | 133 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 60\text{ V}$ (see Figure 17. Test circuit for inductive load switching and diode recovery times) | - | 651 | | nC |
| I_{RRM} | Reverse recovery current | | - | 10 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ | - | 157 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 17. Test circuit for inductive load switching and diode recovery times) | - | 895 | | nC |
| I_{RRM} | Reverse recovery current | | - | 11 | | A |

1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

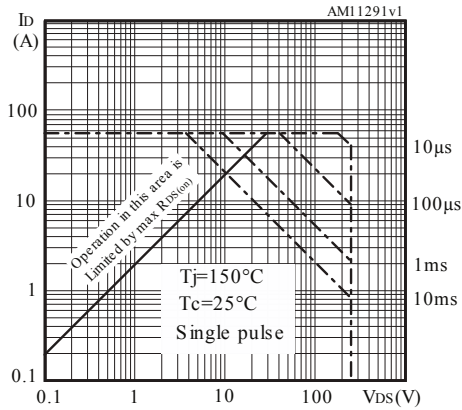
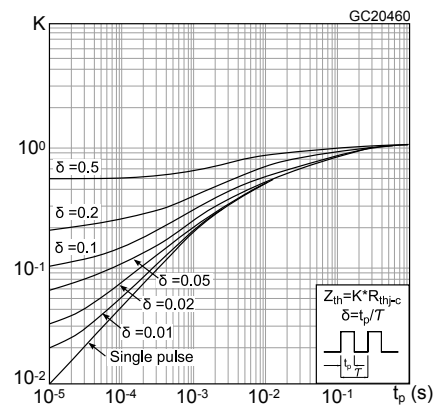
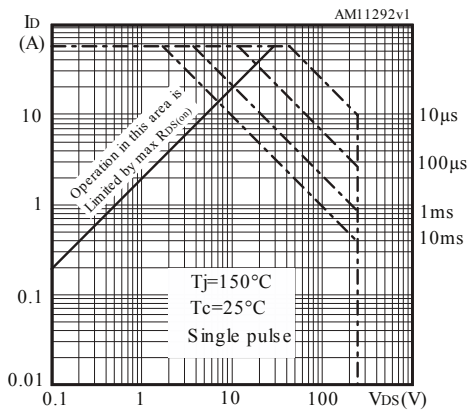
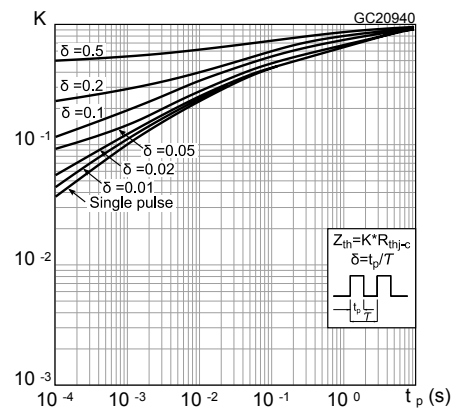
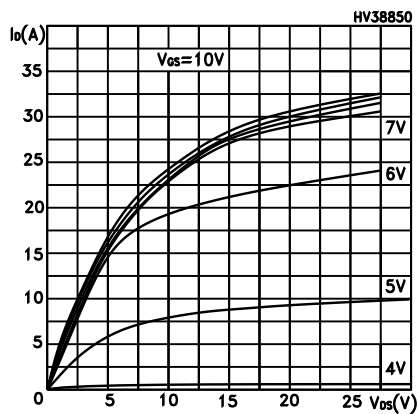
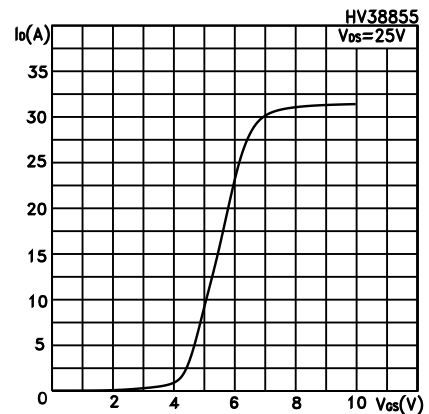
Figure 1. Safe operating area for DPAK

Figure 2. Thermal impedance for DPAK

Figure 3. Safe operating area for TO-220FP

Figure 4. Thermal impedance for TO-220FP

Figure 5. Output characteristics

Figure 6. Transfer characteristics


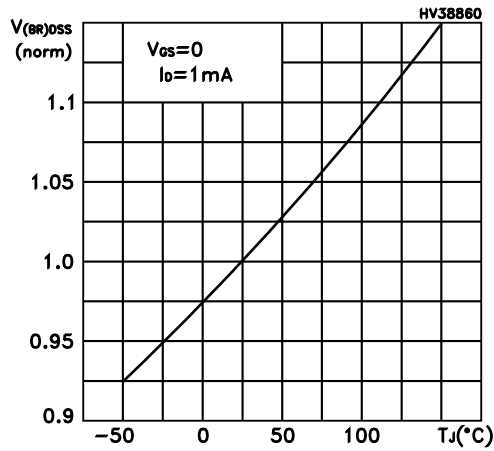
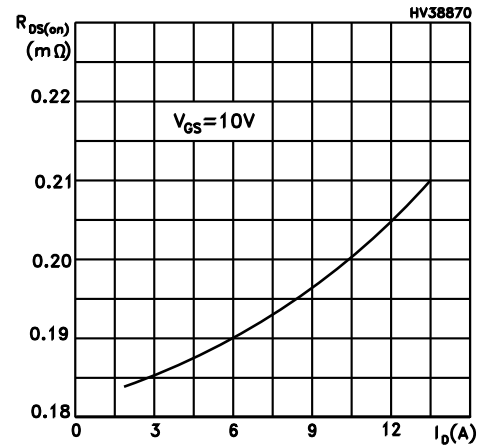
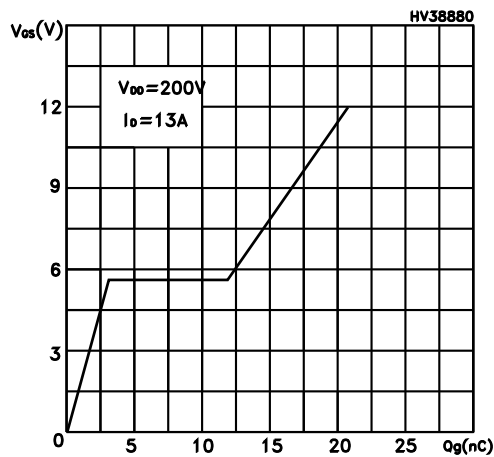
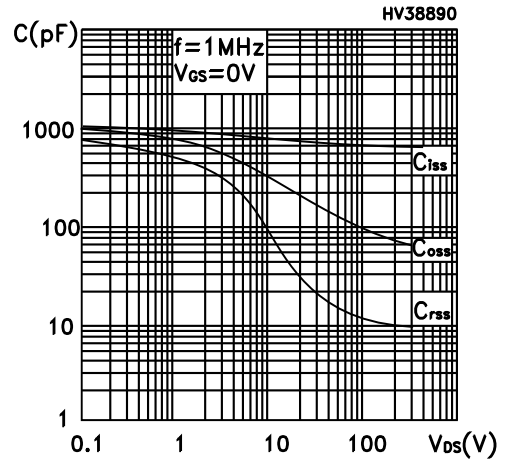
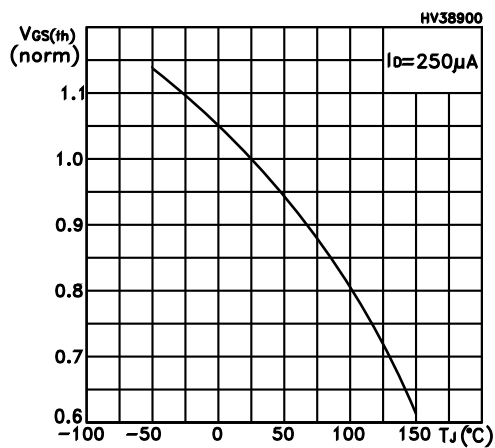
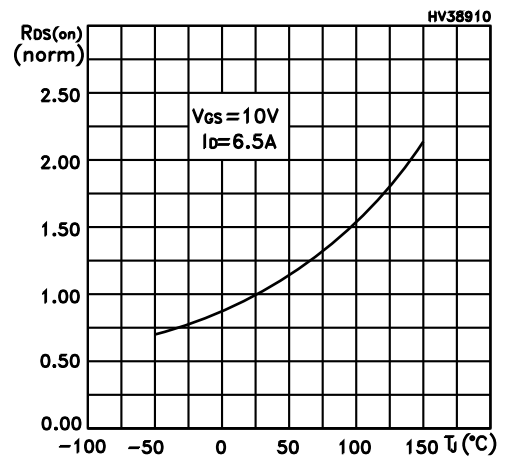
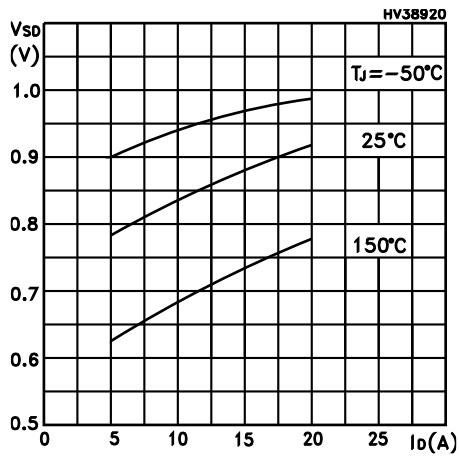
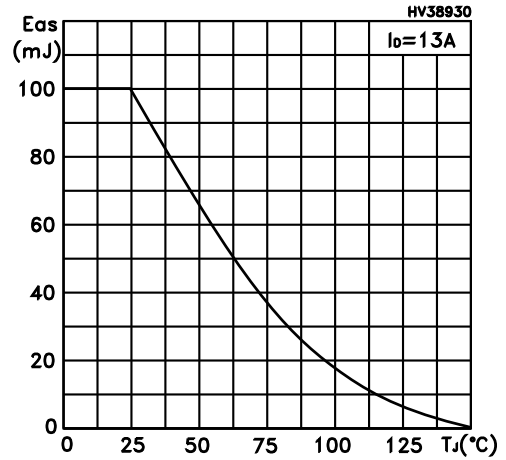
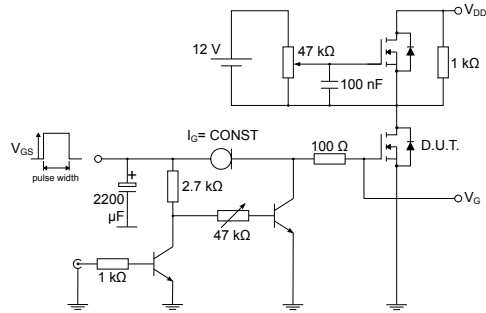
Figure 7. Normalized $V_{(BR)DSS}$ vs temperature

Figure 8. Static drain-source on resistance

Figure 9. Gate charge vs gate-source voltage

Figure 10. Capacitance variations

Figure 11. Normalized gate threshold voltage vs temperature

Figure 12. Normalized on resistance vs temperature


Figure 13. Source-drain diode forward characteristics

Figure 14. Maximum avalanche energy vs temperature


3 Test circuits

Figure 15. Test circuit for resistive load switching times


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Figure 16. Test circuit for gate charge behavior


AM01469v1

Figure 17. Test circuit for inductive load switching and diode recovery times

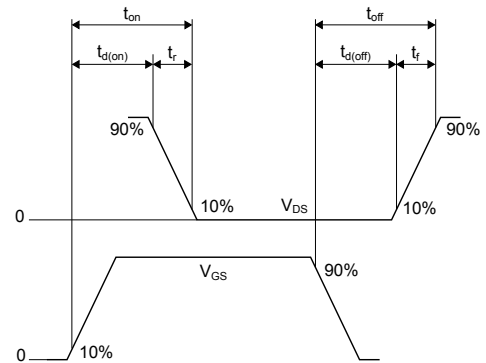

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Figure 18. Unclamped inductive load test circuit


AM01471v1

Figure 19. Unclamped inductive waveform


AM01472v1

Figure 20. Switching time waveform


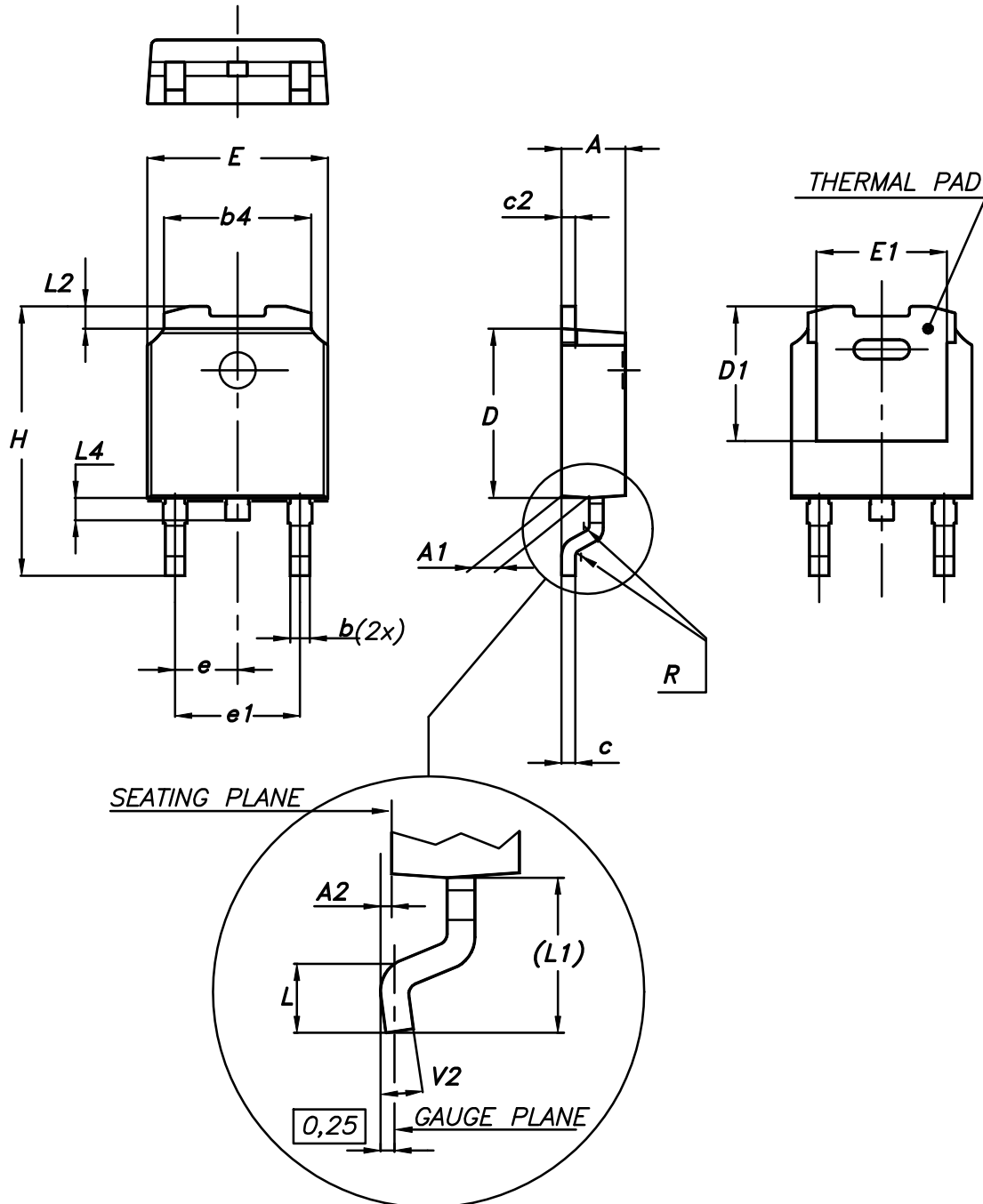
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4 Package information

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 DPAK (TO-252) type A package information

Figure 21. DPAK (TO-252) type A package outline



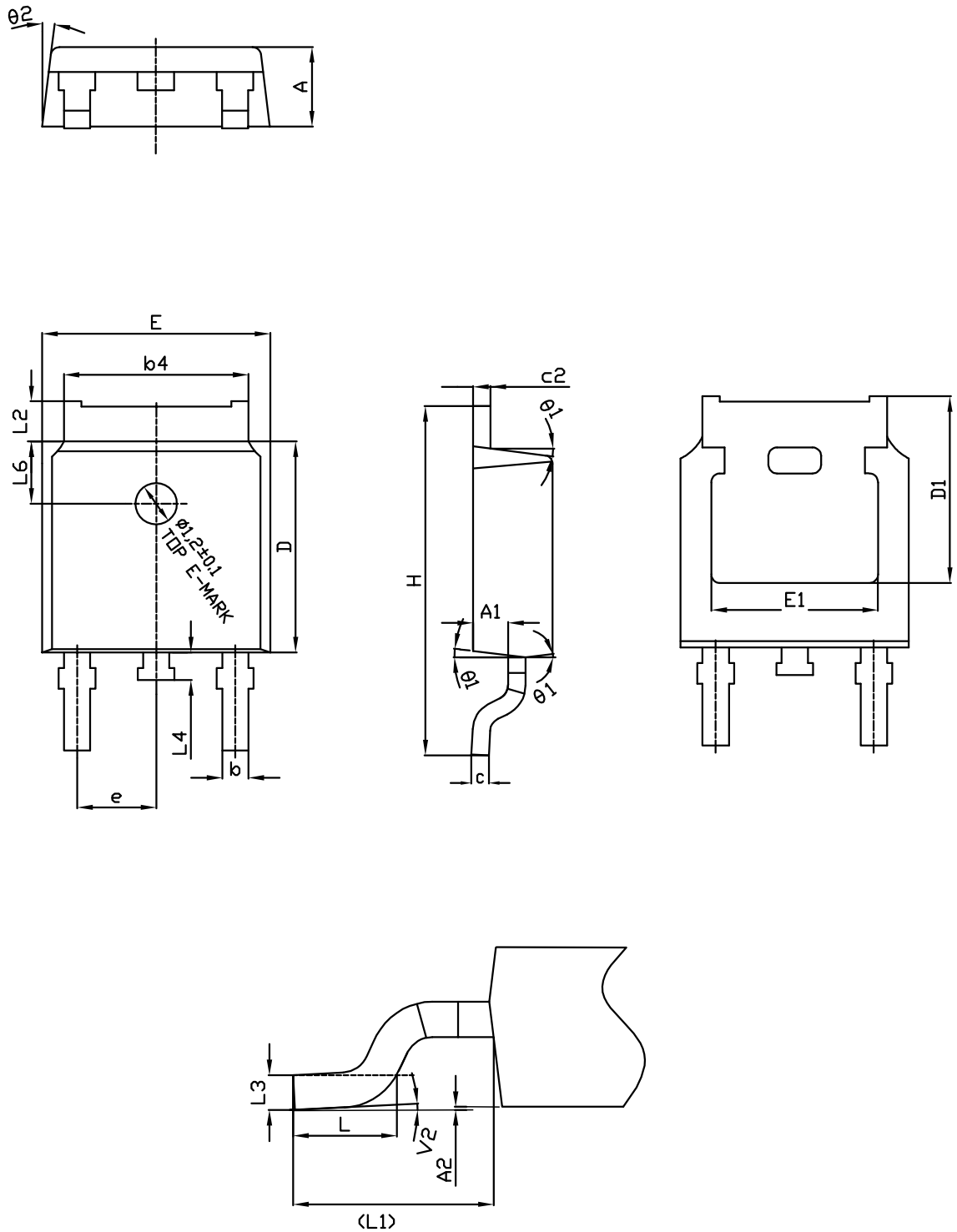
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Table 8. DPAK (TO-252) type A mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | 4.95 | 5.10 | 5.25 |
| E | 6.40 | | 6.60 |
| E1 | 4.60 | 4.70 | 4.80 |
| e | 2.159 | 2.286 | 2.413 |
| e1 | 4.445 | 4.572 | 4.699 |
| H | 9.35 | | 10.10 |
| L | 1.00 | | 1.50 |
| (L1) | 2.60 | 2.80 | 3.00 |
| L2 | 0.65 | 0.80 | 0.95 |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

4.2 DPAK (TO-252) type C2 package information

Figure 22. DPAK (TO-252) type C2 package outline

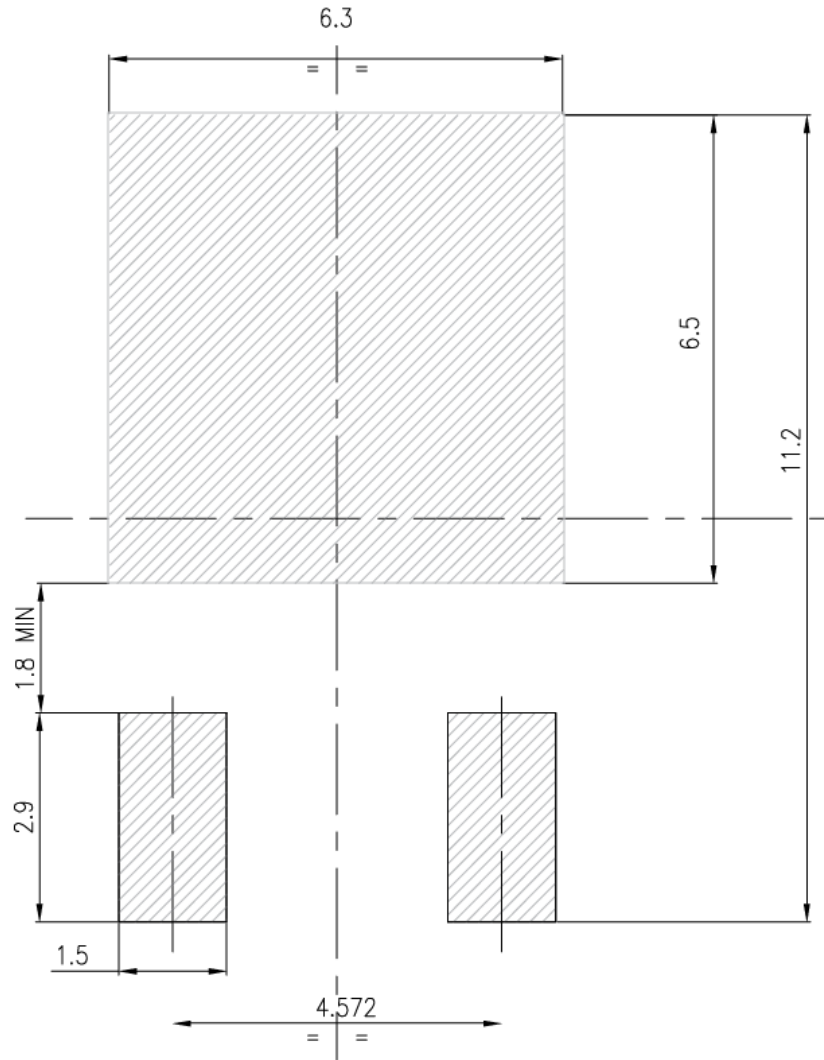


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Table 9. DPAK (TO-252) type C2 mechanical data

| Dim. | mm | | |
|------|----------|-------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0.90 | 1.01 | 1.10 |
| A2 | 0.00 | | 0.10 |
| b | 0.72 | | 0.85 |
| b4 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | | 0.60 |
| c2 | 0.47 | | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.10 | | 5.60 |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 5.20 | | 5.50 |
| e | 2.186 | 2.286 | 2.386 |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 2.90 REF | | |
| L2 | 0.90 | | 1.25 |
| L3 | 0.51 BSC | | |
| L4 | 0.60 | 0.80 | 1.00 |
| L6 | 1.80 BSC | | |
| θ1 | 5° | 7° | 9° |
| θ2 | 5° | 7° | 9° |
| V2 | 0° | | 8° |

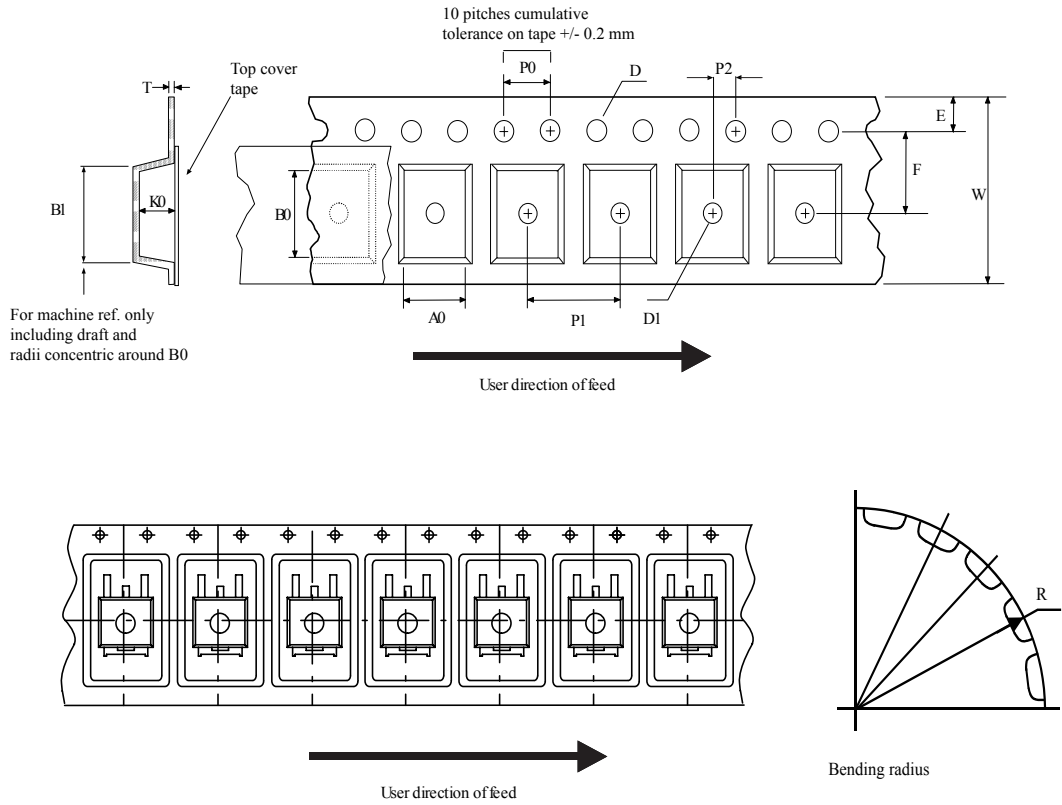
Figure 23. DPAK (TO-252) recommended footprint (dimensions are in mm)



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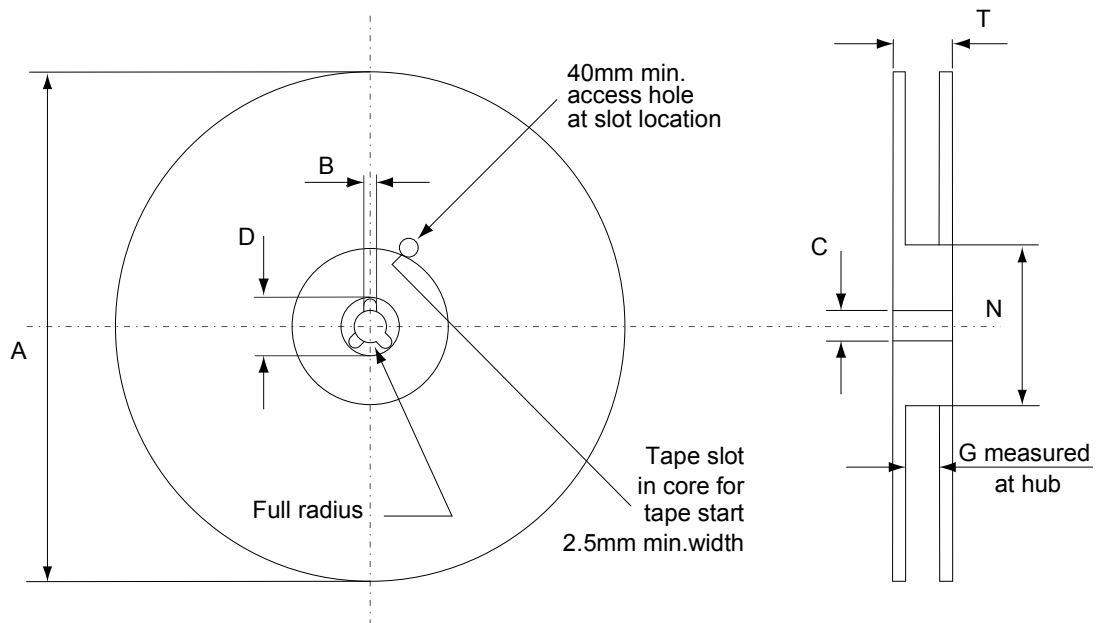
4.3 DPAK (TO-252) packing information

Figure 24. DPAK (TO-252) tape outline



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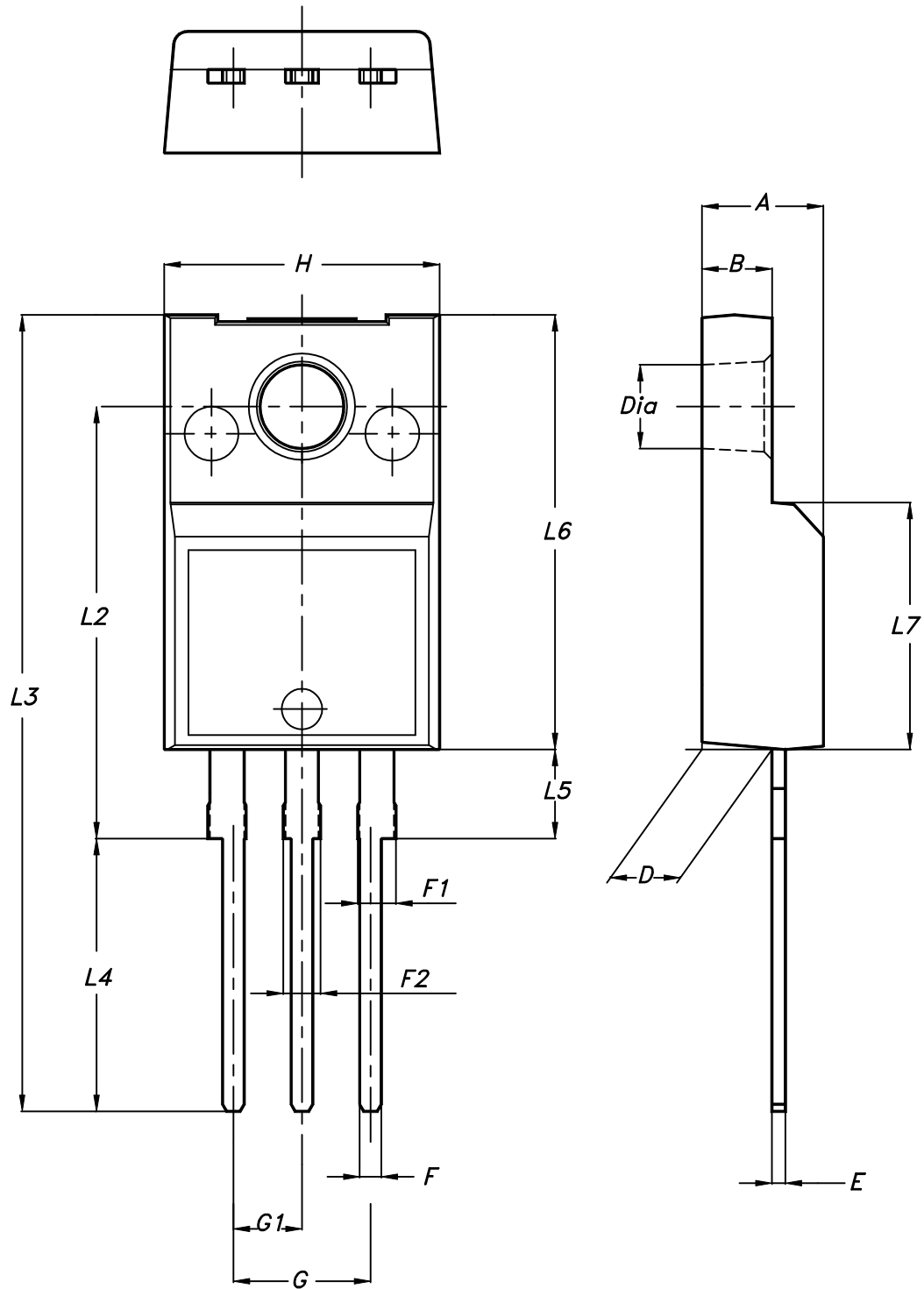
Figure 25. DPAK (TO-252) reel outline



AM06038v1

Table 10. DPAK (TO-252) tape and reel mechanical data

| Dim. | Tape | | Dim. | Reel | |
|------|------|------|------|-----------|------|
| | mm | | | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 6.8 | 7 | A | | 330 |
| B0 | 10.4 | 10.6 | B | 1.5 | |
| B1 | | 12.1 | C | 12.8 | 13.2 |
| D | 1.5 | 1.6 | D | 20.2 | |
| D1 | 1.5 | | G | 16.4 | 18.4 |
| E | 1.65 | 1.85 | N | 50 | |
| F | 7.4 | 7.6 | T | | 22.4 |
| K0 | 2.55 | 2.75 | | | |
| P0 | 3.9 | 4.1 | | Base qty. | 2500 |
| P1 | 7.9 | 8.1 | | Bulk qty. | 2500 |
| P2 | 1.9 | 2.1 | | | |
| R | 40 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 15.7 | 16.3 | | | |

4.4 TO-220FP package information
Figure 26. TO-220FP package outline


7012510_Rev_12_B

Table 11. TO-220FP package 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 |

5 Ordering information

Table 12. Order codes

| Order code | Marking | Package | Packing |
|------------|---------|----------|---------------|
| STD16NF25 | 16NF25 | DPAK | Tape and reel |
| STF16NF25 | | TO-220FP | Tube |

Revision history

Table 13. Document revision history

| Date | Version | Changes |
|-------------|---------|--|
| 12-Oct-2007 | 1 | Initial release. |
| 13-Nov-2007 | 2 | Modified: <i>Figure 13: Capacitance variations.</i> |
| 29-Mar-2012 | 3 | <i>Figure 2: Safe operating area for TO-220, Figure 4: Safe operating area for TO-220FP and Figure 6: Safe operating area for DPAK</i> have been updated. <i>Section 4: Package mechanical data and Section 5: Packaging mechanical data</i> have been updated. Minor text changes |
| 06-Mar-2013 | 4 | – Modified: PTOT, derating factor values, <i>note 1 on Table 2</i> , Rthj-case, Rthj-amb only for TO-220 and DPAK – Updated: <i>Section 4: Package mechanical data</i> – Minor text changes |
| 21-Jan-2019 | 5 | The part number STP16NF25 has been moved to a separate datasheet. Removed maturity status indication from cover page. The document status is production data. Updated Section 4 Package information . Minor text changes. |

Contents

| | | |
|------------|---|-----------|
| 1 | Electrical ratings | 2 |
| 2 | Electrical characteristics | 3 |
| 2.1 | Electrical characteristics (curves) | 5 |
| 3 | Test circuits | 8 |
| 4 | Package information | 9 |
| 4.1 | DPAK (TO-252) type A package information | 9 |
| 4.2 | DPAK (TO-252) type C2 package information | 11 |
| 4.3 | DPAK (TO-252) packing information | 14 |
| 4.4 | TO-220FP package information | 16 |
| 5 | Ordering information | 19 |
| | Revision history | 20 |

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