

N-channel 30 V, 0.0072 Ω typ., 48 A STripFET™ V Power MOSFET in a DPAK package

Datasheet - not recommended for new design

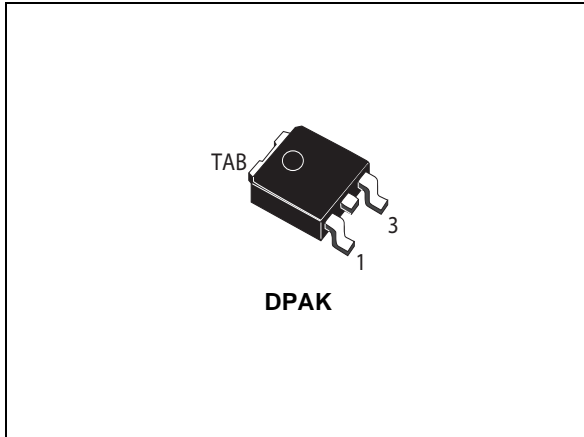
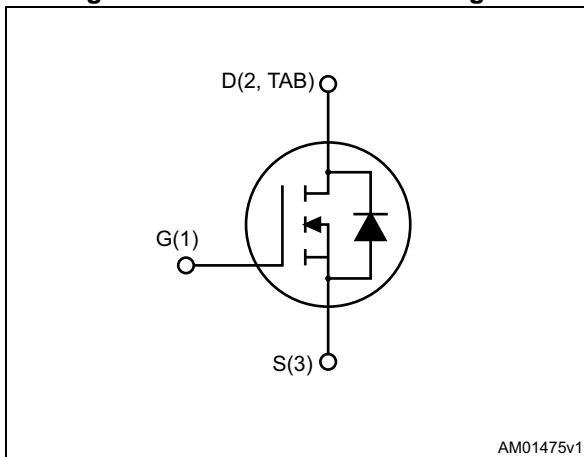


Figure 1. Internal schematic diagram



Features

| Order code | V_{DS} @ T_{jmax} | $R_{DS(on)}$ max | I_D |
|------------|-----------------------|------------------|-------|
| STD60N3LH5 | 35 V | 0.008 Ω | 48 A |

- $R_{DS(on)}$ * Q_g industry benchmark
- Extremely low on-resistance $R_{DS(on)}$
- Very low switching gate charge
- High avalanche ruggedness
- Low gate drive power losses

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using STMicroelectronics' STripFET™V technology. The device has been optimized to achieve very low on-state resistance, contributing to a FOM that is among the best in its class.

Table 1. Device summary

| Order code | Marking | Packages | Packaging |
|------------|---------|----------|---------------|
| STD60N3LH5 | 60N3LH5 | DPAK | Tape and reel |

Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------------|-----------------------------------------------------------------|------------|---------------------|
| V_{DS} | Drain-source voltage | 30 | V |
| V_{DS} | Drain-source voltage @ T_{jmax} | 35 | V |
| V_{GS} | Gate-source voltage | ± 20 | V |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 48 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 42.8 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 192 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 60 | W |
| | Derating factor | 0.4 | W/ $^\circ\text{C}$ |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy | 160 | mJ |
| T_j T_{stg} | Operating junction temperature Storage temperature | -55 to 175 | $^\circ\text{C}$ |

1. Limited by wire bonding.
2. Pulse width limited by safe operating area.
3. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = 24\text{ A}$, $V_{DD} = 12\text{ V}$.

Table 3. Thermal resistance

| Symbol | Parameter | Value | Unit |
|---------------------|---------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max. | 2.5 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max. | 50 | $^\circ\text{C}/\text{W}$ |

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

2 Electrical characteristics

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

Table 4. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--------------------------------------------------|--------------------------------------------------------------------------|------|--------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage | $I_D = 250\ \mu\text{A}$, $V_{GS} = 0$ | 30 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 30\text{ V}$ $V_{DS} = 30\text{ V}$, $T_C = 125\text{ °C}$ | | | 1 10 | μA μA |
| I_{GSS} | Gate body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20\text{ V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ | 1 | 1.8 | 3 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 24\text{ A}$ | | 0.0072 | 0.008 | Ω |
| | | $V_{GS} = 5\text{ V}$, $I_D = 24\text{ A}$ | | 0.0088 | 0.011 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------------|-----------------------------------------------------------------------------------------------|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 1350 | 1620 | pF |
| C_{oss} | Output capacitance | | - | 265 | 318 | pF |
| C_{rss} | Reverse transfer capacitance | | - | 32 | 38 | pF |
| Q_g | Total gate charge | $V_{DD} = 15\text{ V}$, $I_D = 48\text{ A}$ $V_{GS} = 5\text{ V}$ (<i>Figure 14</i>) | - | 8.8 | 12.3 | nC |
| Q_{gs} | Gate-source charge | | - | 4.7 | 6.6 | nC |
| Q_{gd} | Gate-drain charge | | - | 2.2 | 3.1 | nC |
| Q_{gs1} | Pre V_{th} gate-to-source charge | $V_{DD} = 15\text{ V}$, $I_D = 48\text{ A}$ $V_{GS} = 5\text{ V}$ (<i>Figure 19</i>) | - | 2.2 | 3.1 | nC |
| Q_{gs2} | Post V_{th} gate-to-source charge | | - | 2.5 | 3.5 | nC |
| R_G | Gate input resistance | $f = 1\text{ MHz}$, gate DC Bias = 0, test signal level = 20 mV, $I_D = 0$ | - | 1.1 | 1.3 | Ω |

Table 6. Switching on/off (resistive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}=10\text{ V}$, $I_D=24\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ (<i>Figure 13</i> and <i>Figure 18</i>) | - | 6 | - | ns |
| t_r | Rise time | | - | 33 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 19 | - | ns |
| t_f | Fall time | | - | 4.2 | - | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|------|
| I_{SD} | Source-drain current | | - | | 48 | A |
| I_{SDM} | Source-drain current (pulsed) ⁽¹⁾ | | - | | 192 | A |
| V_{SD} | Forward on voltage | $I_{SD}=24\text{ A}$, $V_{GS}=0$ | - | | 1.1 | V |
| t_{rr} | Reverse recovery time | $I_{SD}=48\text{ A}$, $di/dt=100\text{ A}/\mu\text{s}$, $V_{DD}=20\text{ V}$, (<i>Figure 15</i>) | - | 25 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 18.5 | | nC |
| I_{RRM} | Reverse recovery current | | - | 1.5 | | A |

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

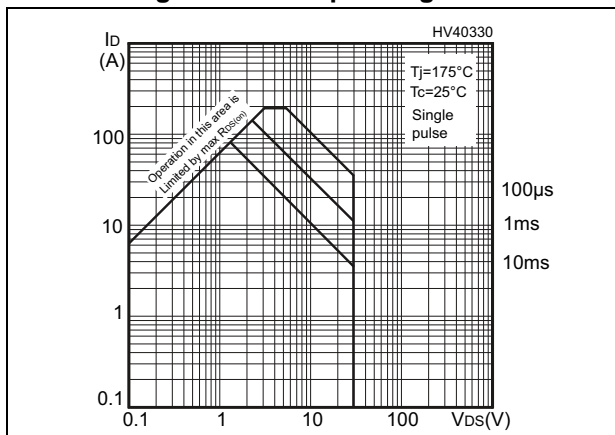


Figure 3. Thermal impedance

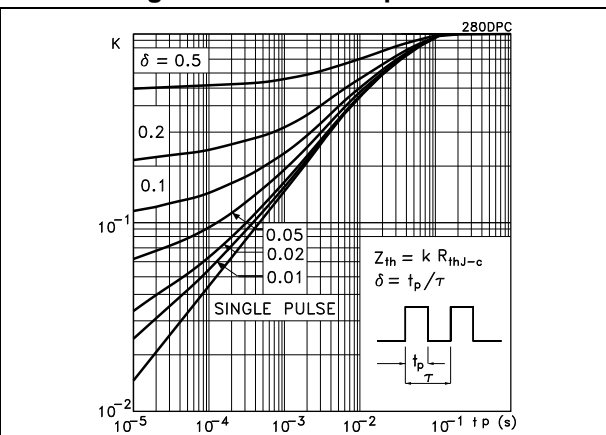


Figure 4. Output characteristics

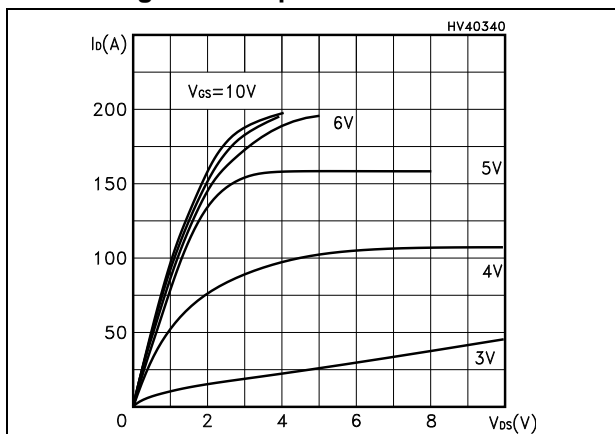


Figure 5. Transfer characteristics

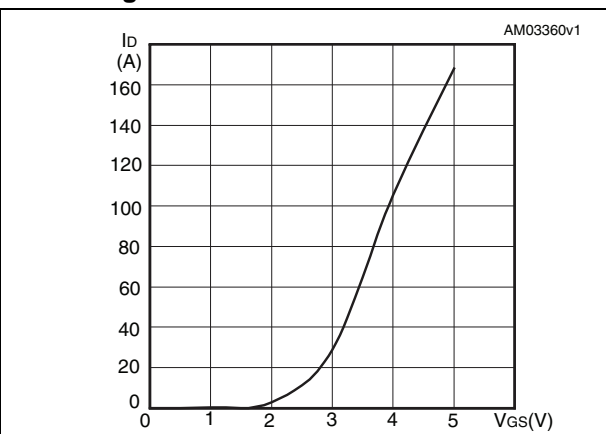


Figure 6. Normalized $V_{(BR)DSS}$ vs temperature

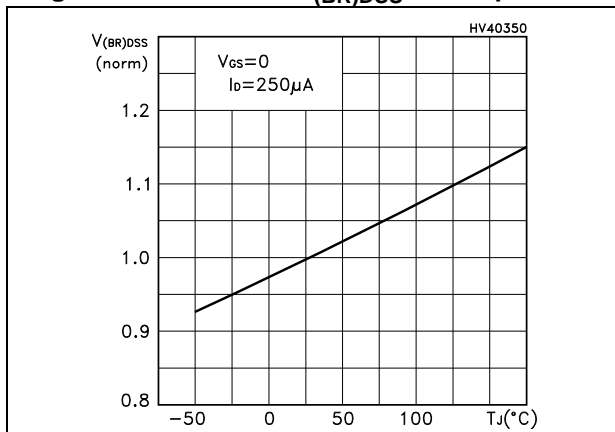


Figure 7. Static drain-source on-resistance

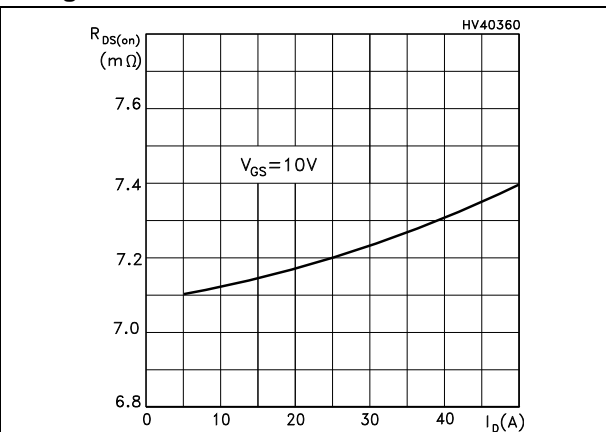


Figure 8. Gate charge vs gate-source voltage

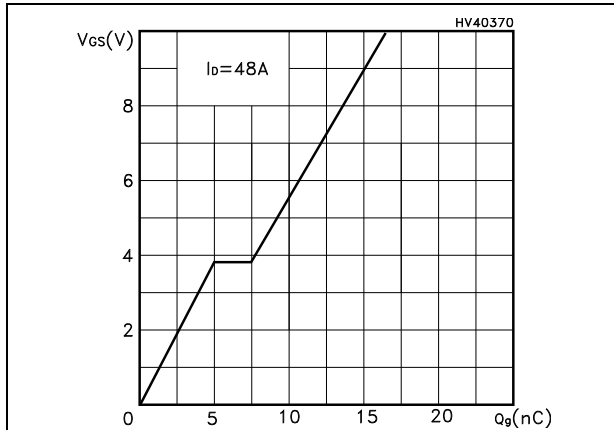


Figure 9. Capacitance variations

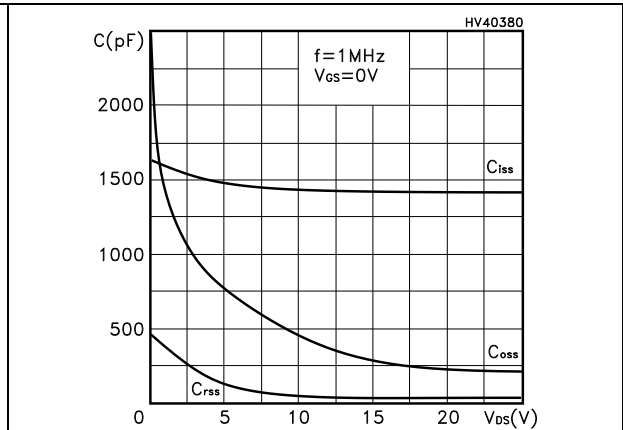


Figure 10. Normalized gate threshold voltage vs temperature

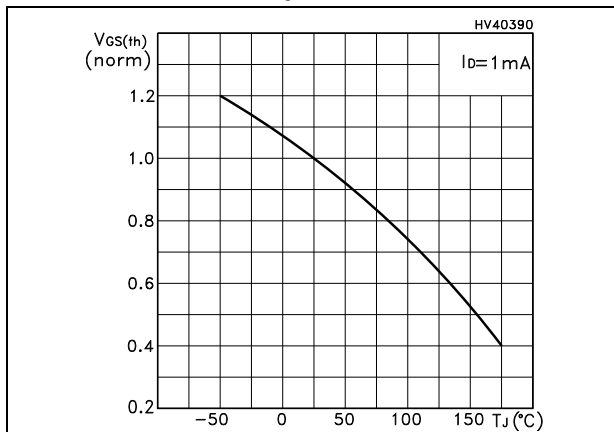


Figure 11. Normalized on-resistance vs temperature

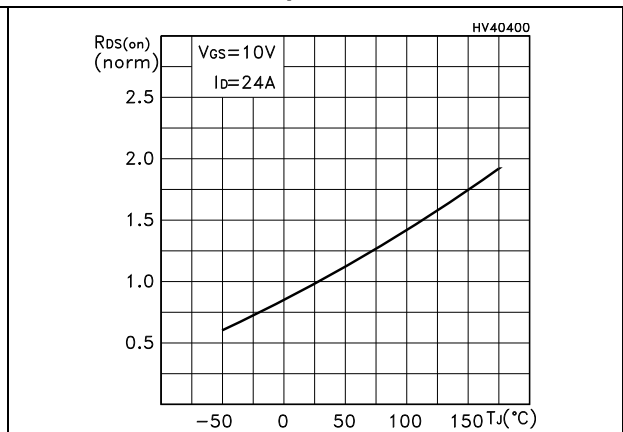
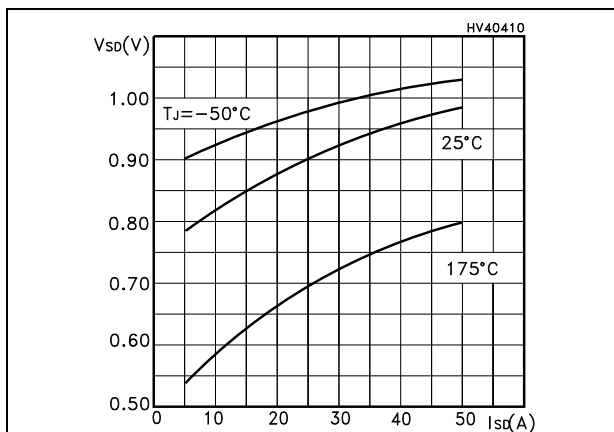


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load



Figure 14. Gate charge test circuit



Figure 15. Test circuit for inductive load switching and diode recovery times



Figure 16. Unclamped inductive load test circuit



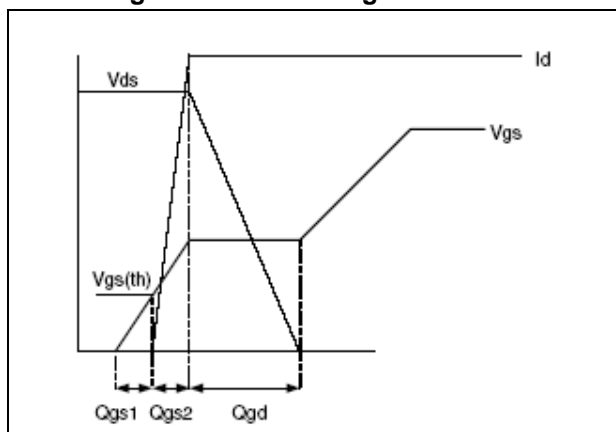
Figure 17. Unclamped inductive waveform



Figure 18. Switching time waveform



Figure 19. Gate charge 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. 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 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1.00 | | 1.50 |
| (L1) | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

Figure 20. DPAK (TO-252) type A drawing

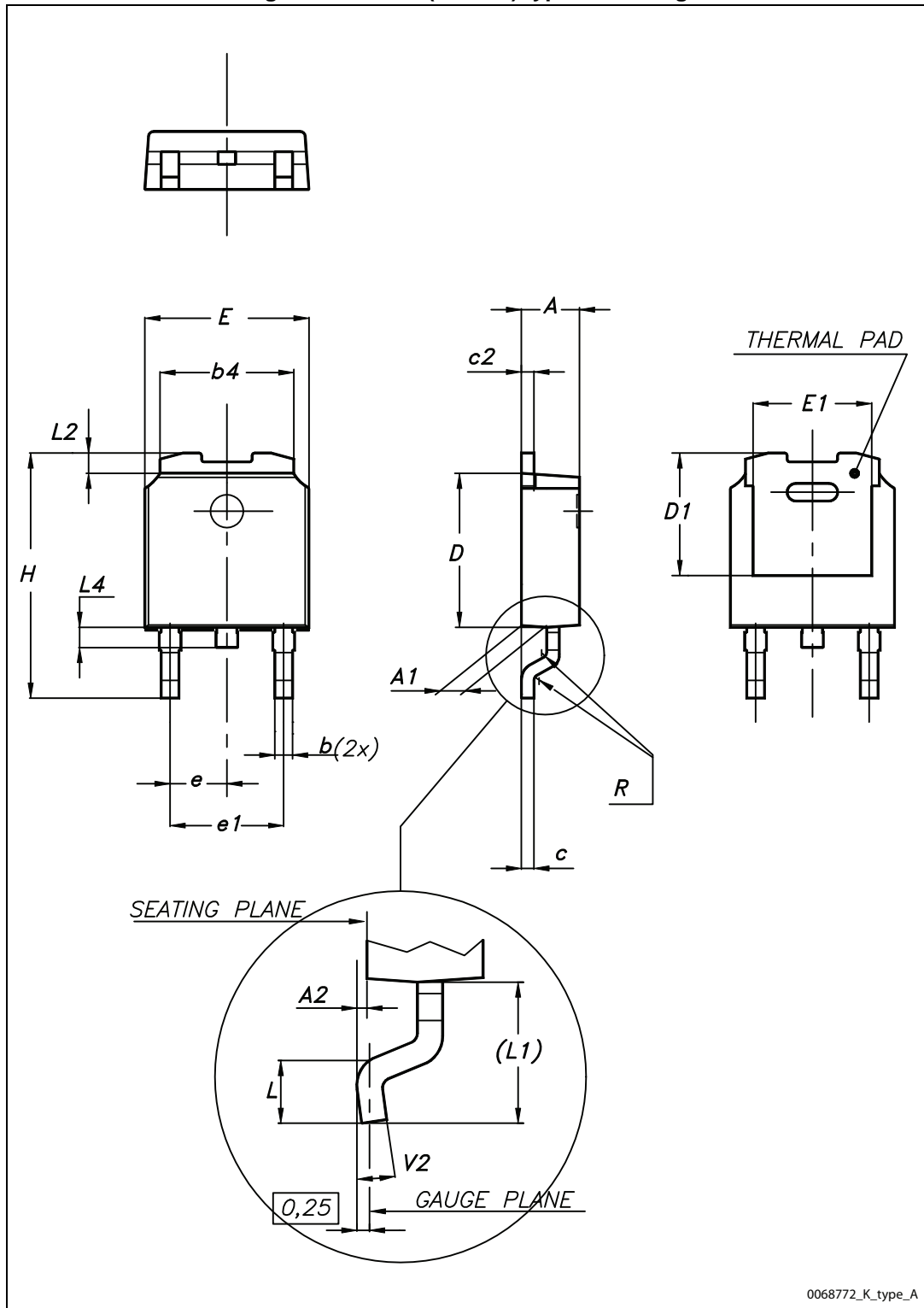


Table 9. DPAK (TO-252) type E mechanical data

| Dim. | mm | | |
|------|------|-------|-------|
| | Min. | Typ. | Max. |
| A | 2.18 | | 2.39 |
| A2 | | | 0.13 |
| b | 0.65 | | 0.884 |
| b4 | 4.95 | | 5.46 |
| c | 0.46 | | 0.61 |
| c2 | 0.46 | | 0.60 |
| D | 5.97 | | 6.22 |
| D1 | 5.21 | | |
| E | 6.35 | | 6.73 |
| E1 | 4.32 | | |
| e | | 2.286 | |
| e1 | | 4.572 | |
| H | 9.94 | | 10.34 |
| L | 1.50 | | 1.78 |
| L1 | | 2.74 | |
| L2 | 0.89 | | 1.27 |
| L4 | | | 1.02 |

Figure 21. DPAK (TO-252) type E drawing

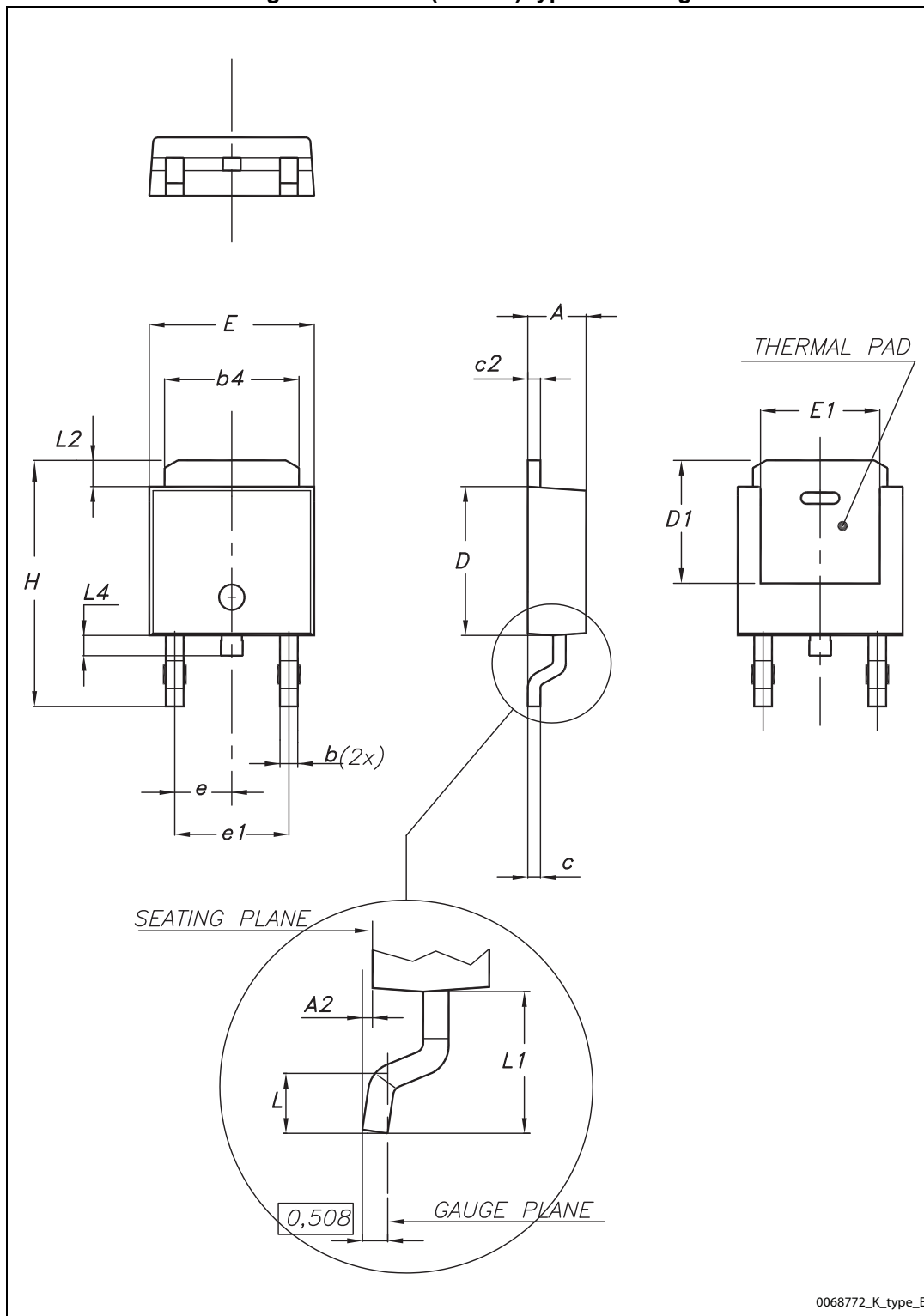
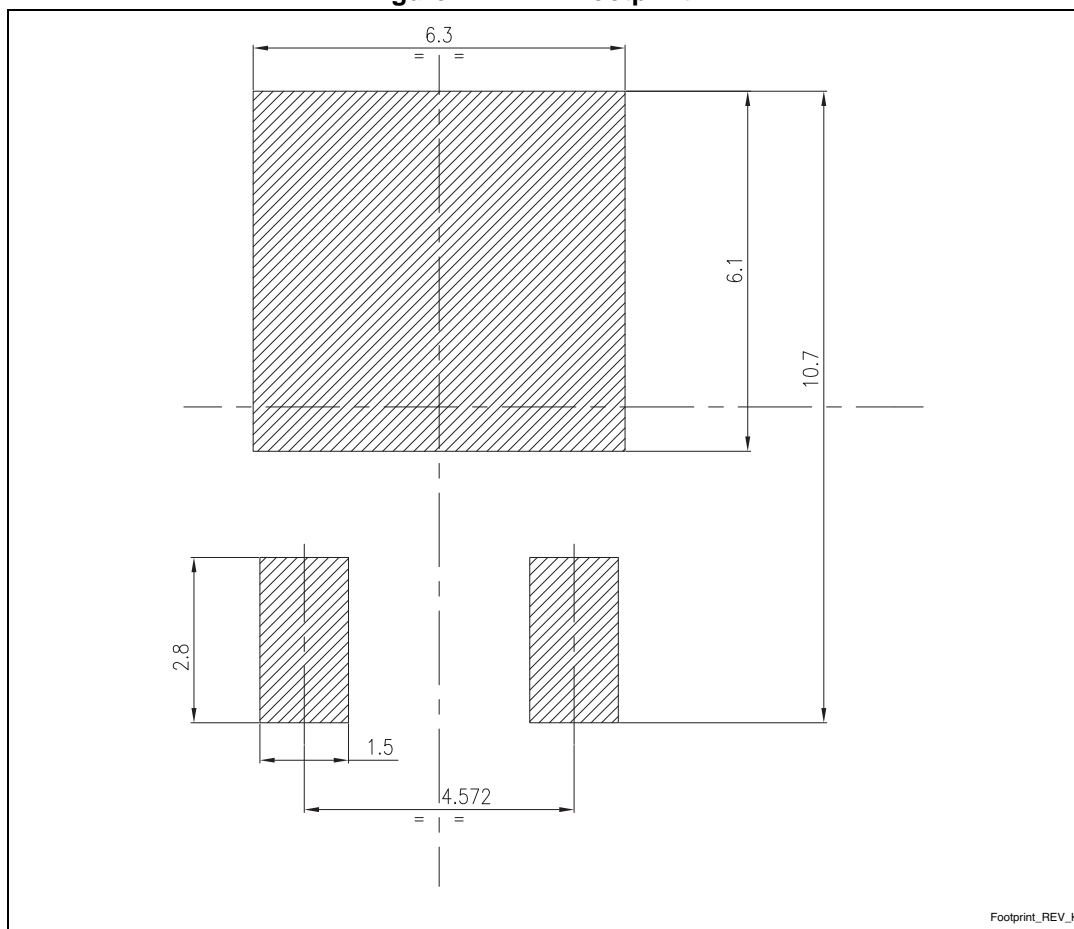


Figure 22. DPAK footprint (a)



a. All dimensions are in millimeters

5 Packaging mechanical data

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

| Tape | | | Reel | | |
|------|------|------|-----------|------|------|
| Dim. | mm | | Dim. | 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 | | | |

Figure 23. Tape for DPAK (TO-252)

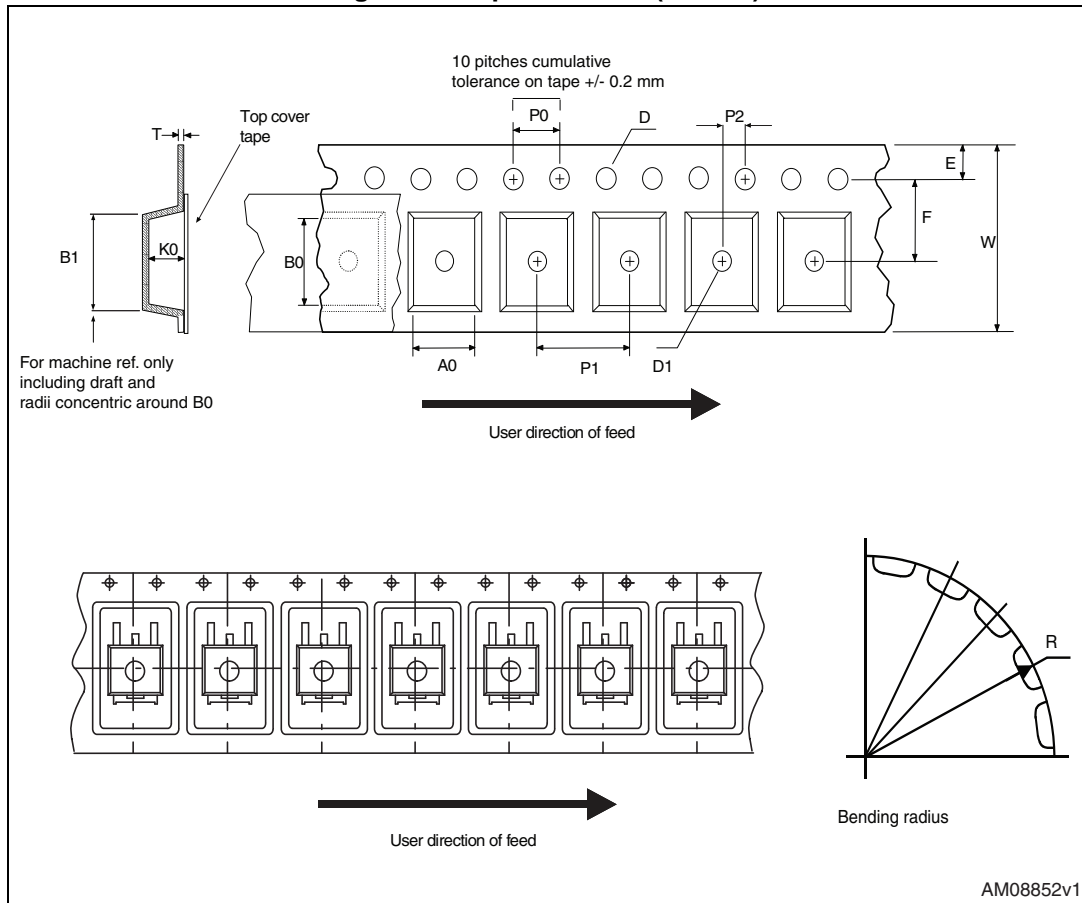
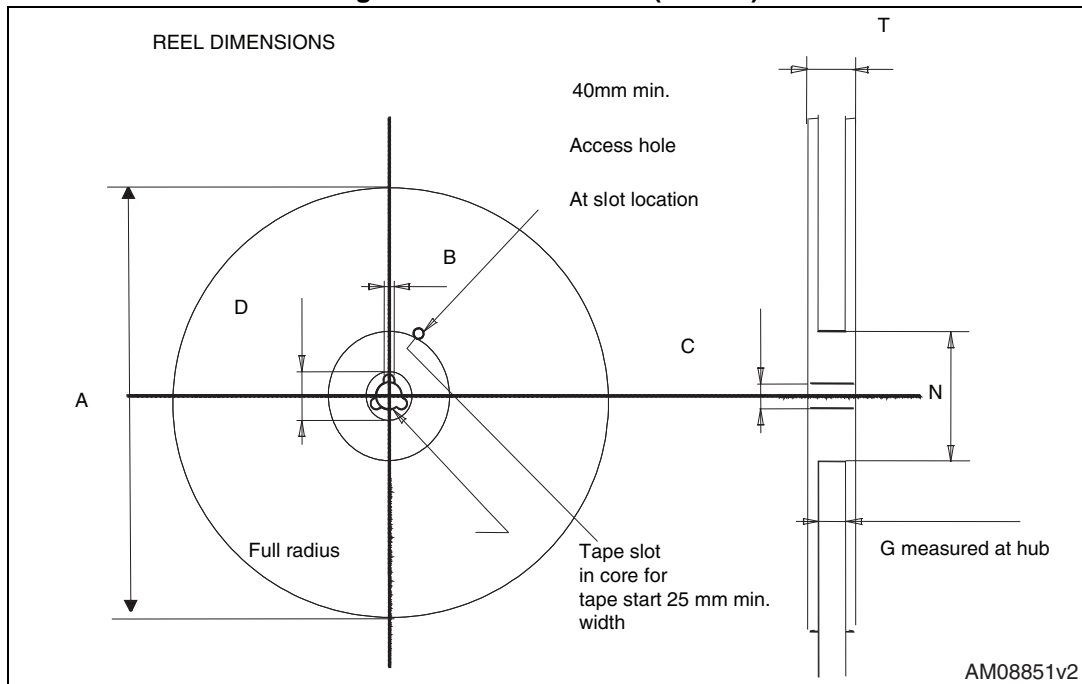


Figure 24. Reel for DPAK (TO-252)



6 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19-Oct-2007 | 1 | First release |
| 23-Sep-2008 | 2 | V_{GS} value has been changed on Table 2 and Table 5 |
| 20-Apr-2009 | 3 | <ul style="list-style-type: none">– Inserted typical maximum value in $V_{GS(th)}$ parameter– Figure 5: Transfer characteristics has been updated– Added device in TO-220 |
| 05-Apr-2011 | 4 | <ul style="list-style-type: none">– Added device in Short IPAK– Added max values in Table 5: Dynamic– V_{GS} value has been changed in Table 2 and Table 4 |
| 09-Aug-2013 | 5 | The part numbers STP60N3LH5, STU60N3LH5 and STU60N3LH5-S have been moved to a separate datasheet |

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