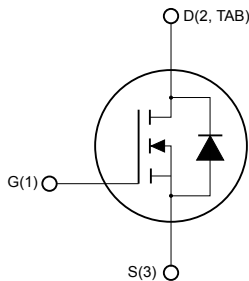
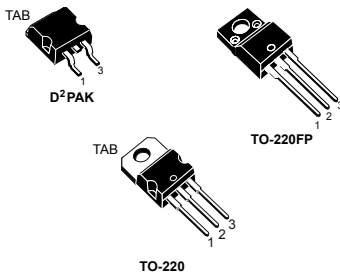


N-channel 500 V, 300 mΩ typ., 12 A MDmesh Power MOSFETs in a D²PAK, TO-220 and TO-220FP packages



NG1D2TS3



Features

| Order codes | V _{DS} | R _{DS(on)} max. | I _D |
|-------------|-----------------|--------------------------|----------------|
| STB12NM50T4 | 500 V | 350 mΩ | 12 A |
| STP12NM50 | | | |
| STP12NM50FP | | | |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

These N-channel Power MOSFETs are developed using STMicroelectronics' revolutionary MDmesh technology, which associates the multiple drain process with the company's PowerMESH horizontal layout. These devices offer extremely low on-resistance, high dv/dt and excellent avalanche characteristics. Utilizing ST's proprietary strip technique, these Power MOSFETs boast an overall dynamic performance which is superior to similar products on the market.

Product status link

[STB12NM50T4](#)
[STP12NM50](#)
[STP12NM50FP](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|---|----------------------------|--------------------|------|
| | | D ² PAK, TO-220 | TO-220FP | |
| V _{GS} | Gate-source voltage | ±30 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 12 | 12 ⁽¹⁾ | A |
| | Drain current (continuous) at T _C = 100 °C | 7.5 | 7.5 ⁽¹⁾ | |
| I _{DM} ⁽²⁾ | Drain current pulsed | 48 | 48 ⁽¹⁾ | A |
| P _{TOT} | Total power dissipation at T _C = 25 °C | 160 | 35 | W |
| V _{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T _C = 25 °C) | | 2.5 | kV |
| dv/dt ⁽³⁾ | Peak diode recovery voltage slope | 15 | | V/ns |
| T _J | Operating junction temperature range | -65 to 150 | | °C |
| T _{stg} | Storage temperature range | | | °C |

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- I_{SD} ≤ 12 A, di/dt ≤ 400 A/μs, V_{DD} = 80% V_{(BR)DSS}.

Table 2. Thermal data

| Symbol | Parameter | Value | | | Unit |
|-------------------------------------|-------------------------------------|--------------------|--------|----------|------|
| | | D ² PAK | TO-220 | TO-220FP | |
| R _{thj-case} | Thermal resistance junction-case | 2.78 | | 3.57 | °C/W |
| R _{thj-a} | Thermal resistance junction-ambient | 62.5 | | | °C/W |
| R _{thj-pcb} ⁽¹⁾ | Thermal resistance junction-pcb | 35 | | | °C/W |

- When mounted on an 1-inch² FR-4, 2 Oz copper board.

Table 3. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|-----------------|--|-------|------|
| I _{AS} | Avalanche current, repetitive or not repetitive (pulse width limited by T _J max) | 6 | A |
| E _{AS} | Single-pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AS} , V _{DD} = 50 V) | 400 | mJ |

2 Electrical characteristics

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

Table 4. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|--|------|------|-----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | 500 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾ | | | 10 | |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 30\text{ V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$ | | 300 | 350 | m 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 | $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 1000 | - | pF |
| C_{oss} | Output capacitance | | - | 250 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 20 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0$ to 400 V , $V_{GS} = 0\text{ V}$ | - | 90 | - | pF |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 250\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ | - | 20 | - | ns |
| t_r | Rise Time | (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform) | - | 10 | - | ns |
| Q_g | Total gate charge | $V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 0$ to 10 V | - | 28 | - | nC |
| Q_{gs} | Gate-source charge | (see Figure 14. Test circuit for gate charge behavior) | - | 8 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 16 | - | nC |
| R_g | Gate input resistance | $f = 1\text{ MHz}$, gate DC Bias = 0, test signal level = 20 mV , open drain | - | 1.6 | - | Ω |

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. Source-drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 12 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 48 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = 12\text{ A}$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, | - | 270 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 100\text{ V}$ | - | 2.23 | | μC |
| I_{RRM} | Reverse recovery current | (see Figure 15. Test circuit for inductive load switching and diode recovery times) | - | 16.5 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, | - | 340 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ | - | 3 | | μC |
| I_{RRM} | Reverse recovery current | (see Figure 15. Test circuit for inductive load switching and diode recovery times) | - | 18 | | A |

1. Pulse width is limited by safe operating area.

2. Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for D²PAK and TO-220

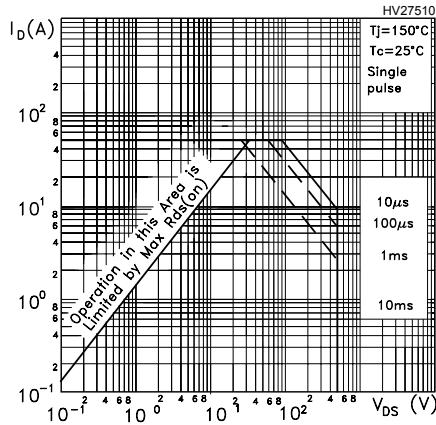


Figure 2. Thermal impedance for D²PAK and TO-220

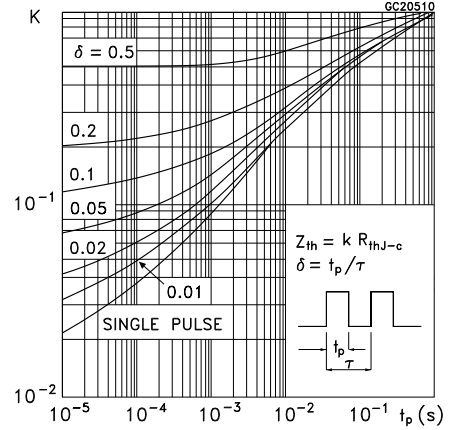


Figure 3. Safe operating area for TO-220FP

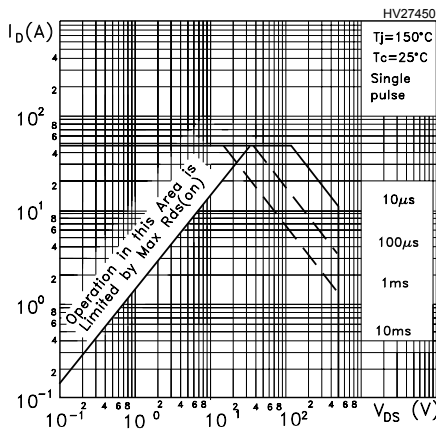


Figure 4. Thermal impedance for TO-220FP

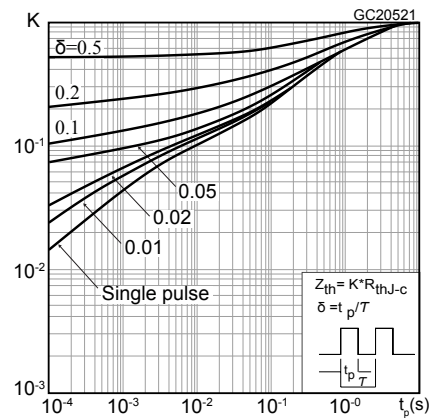


Figure 5. Output characteristics

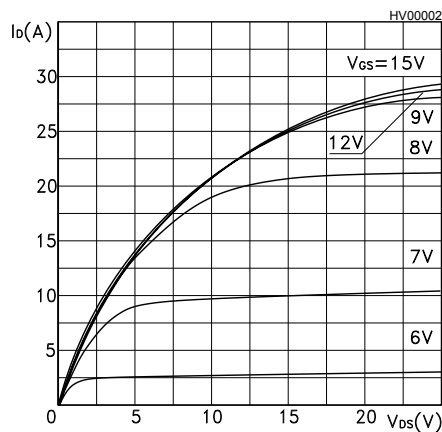


Figure 6. Transfer characteristics

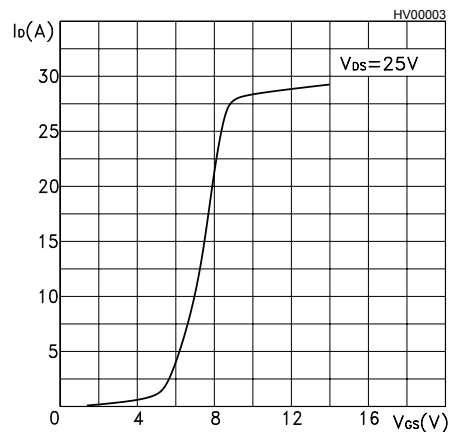
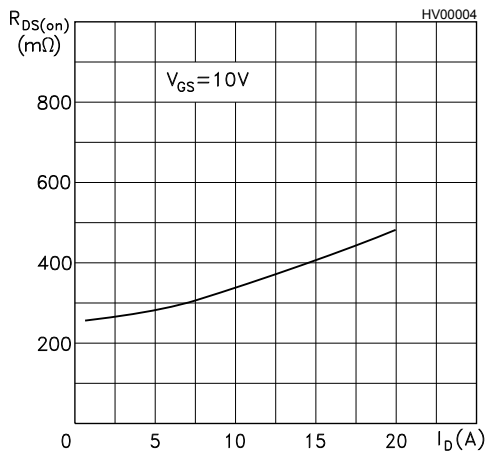
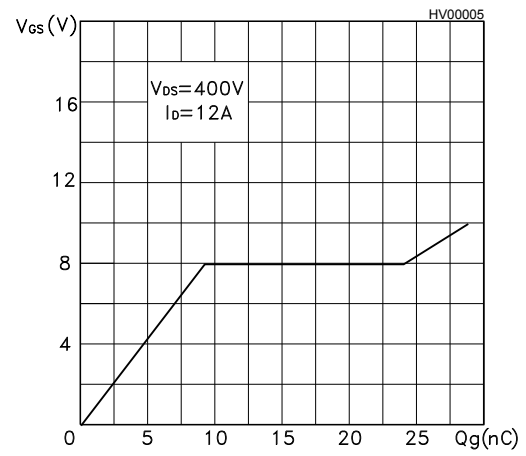
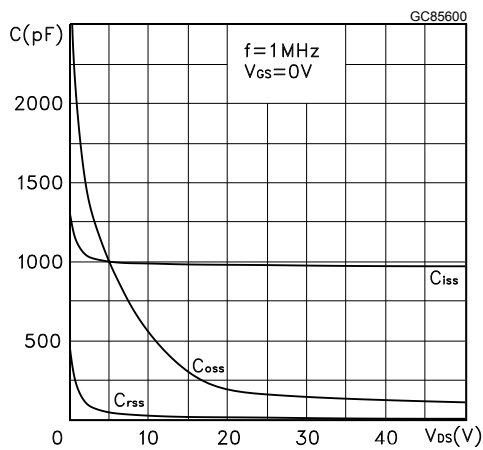
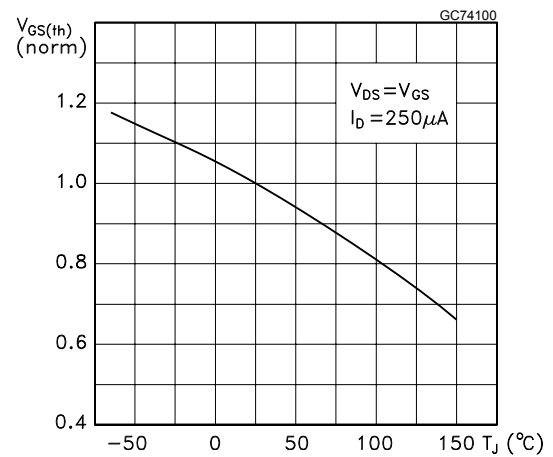
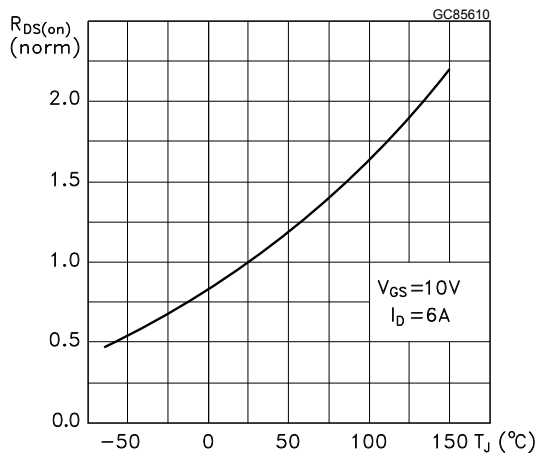
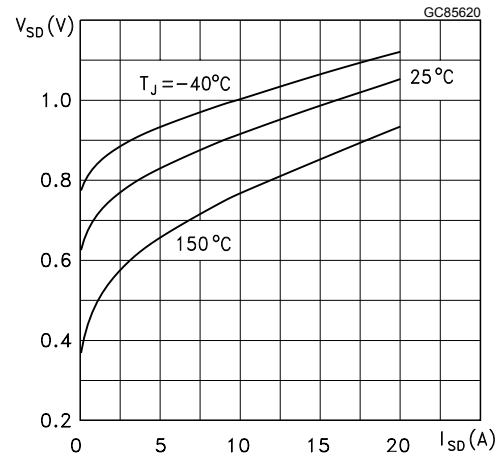
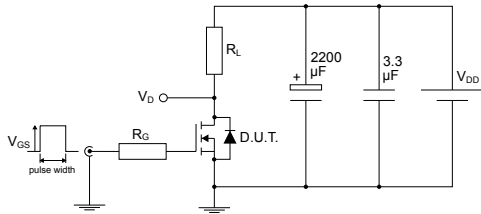
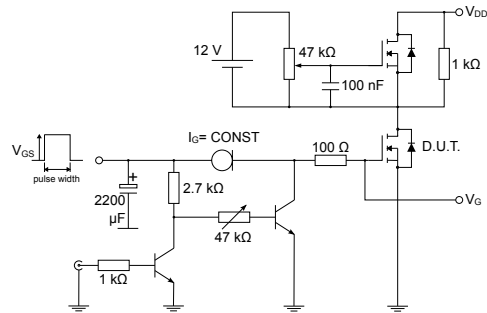


Figure 7. Static drain-source on-resistance

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


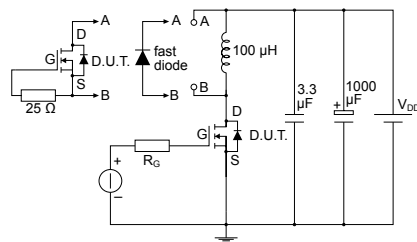
3 Test circuits

Figure 13. Test circuit for resistive load switching times


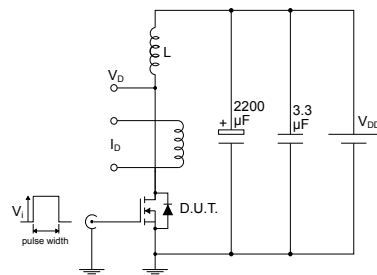
AM01468v1

Figure 14. Test circuit for gate charge behavior


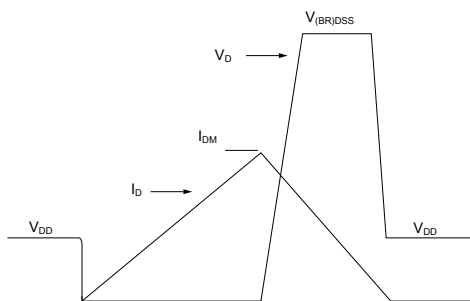
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Figure 15. Test circuit for inductive load switching and diode recovery times


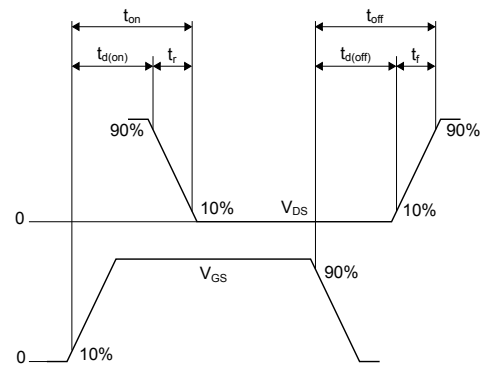
AM01470v1

Figure 16. Unclamped inductive load test circuit


AM01471v1

Figure 17. Unclamped inductive waveform


AM01472v1

Figure 18. Switching time waveform


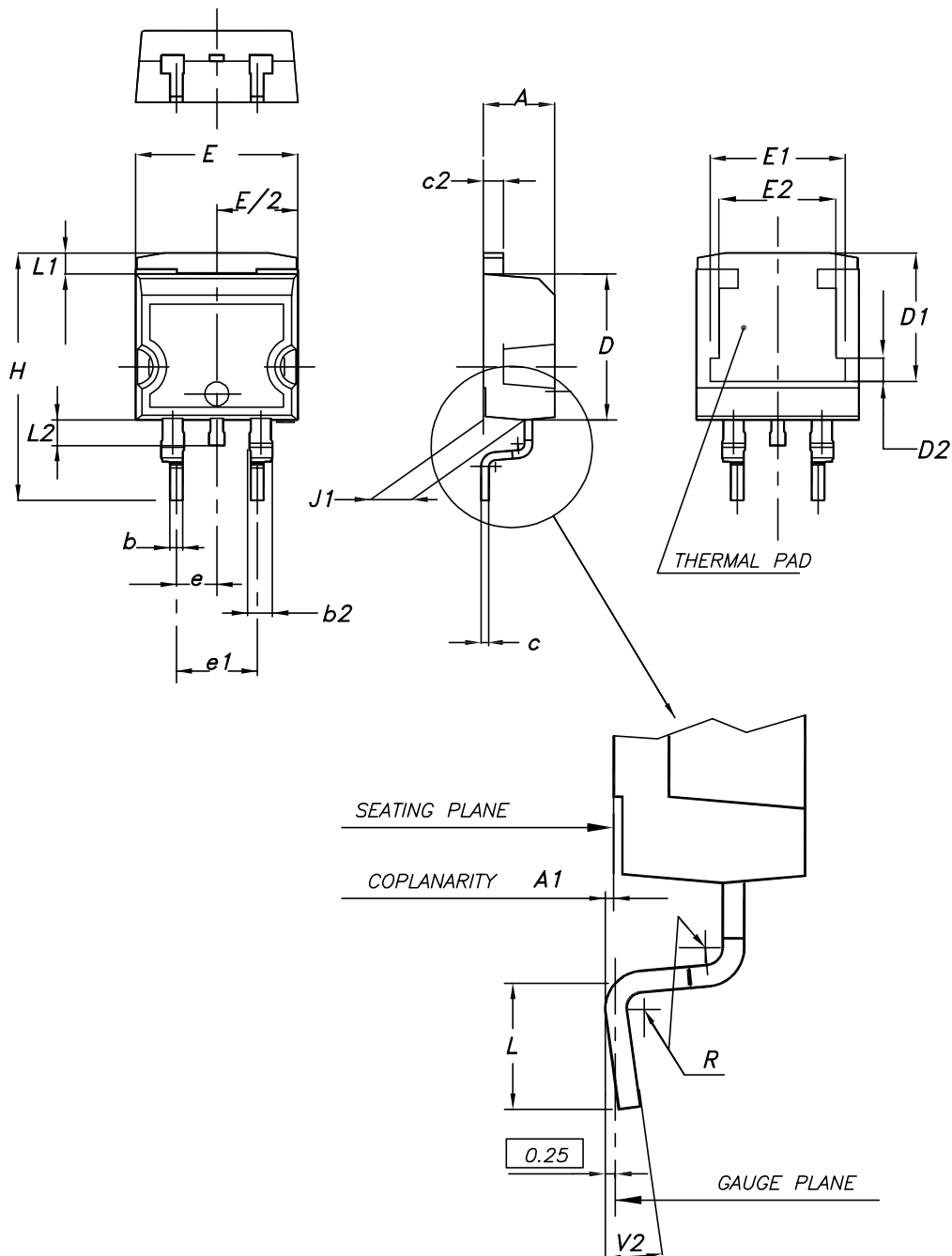
AM01473v1

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 A package information

Figure 19. D²PAK (TO-263) type A package outline

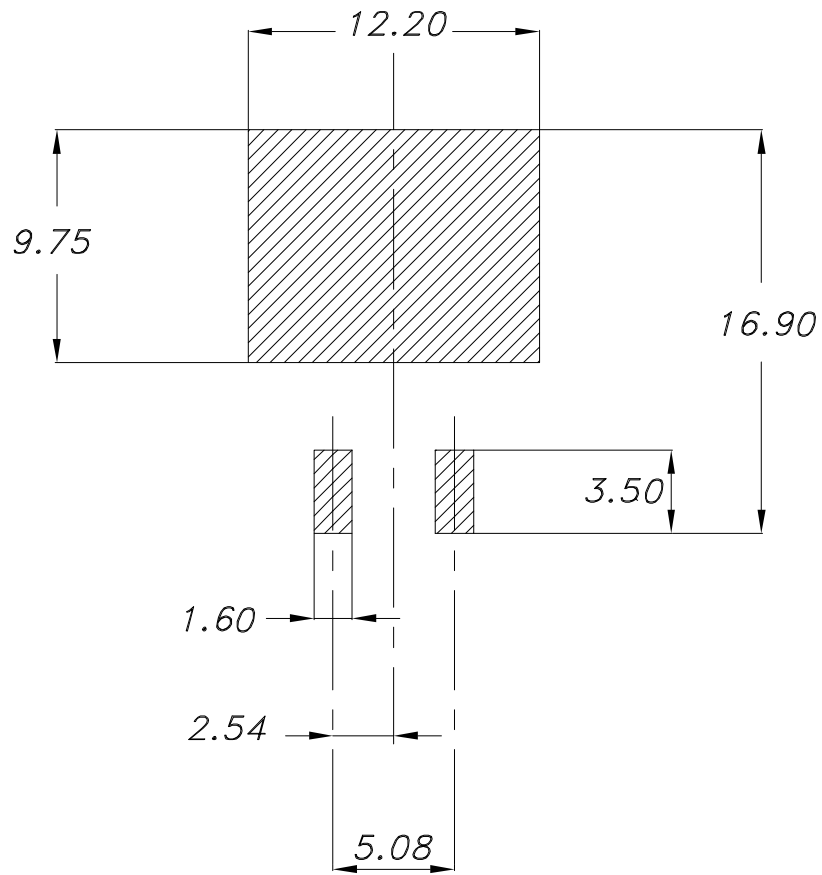


0079457_26

Table 7. D²PAK (TO-263) type A 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 | 8.30 | 8.50 | 8.70 |
| E2 | 6.85 | 7.05 | 7.25 |
| 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° |

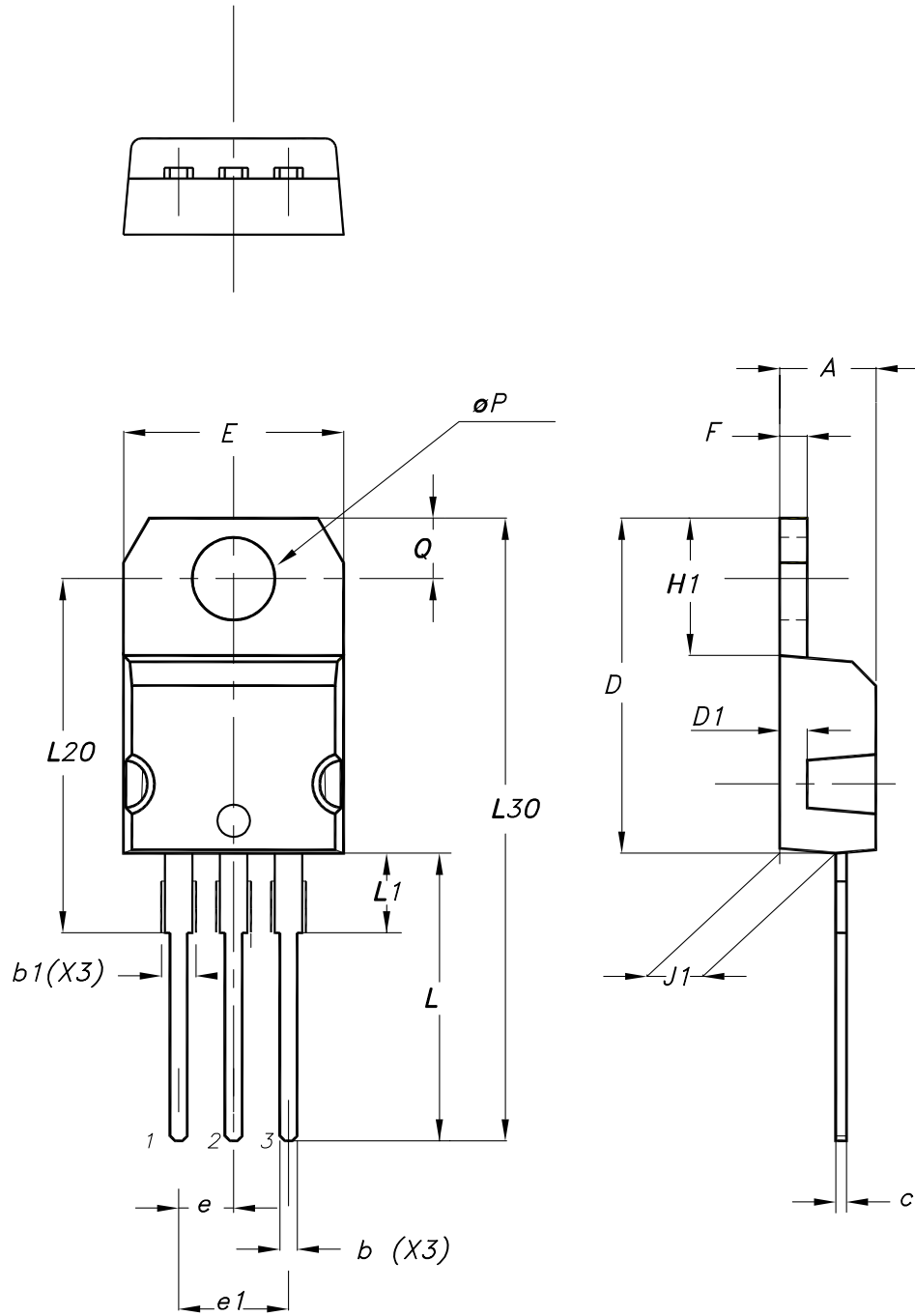
Figure 20. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint_26

4.2 TO-220 type A package information

Figure 21. TO-220 type A package outline



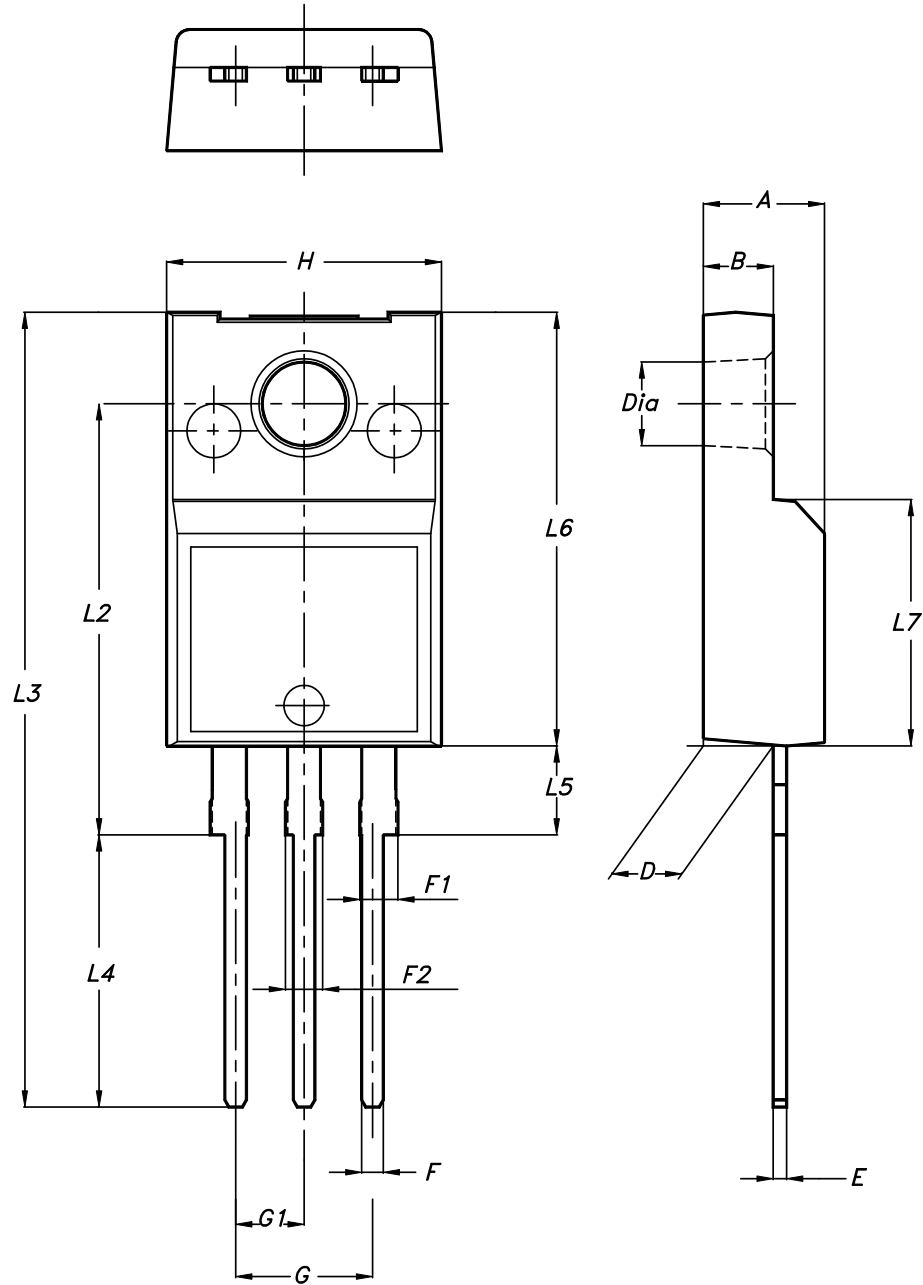
0015988_typeA_Rev_23

Table 8. 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 |
| Slug flatness | | 0.03 | 0.10 |

4.3 TO-220FP package information

Figure 22. TO-220FP package outline



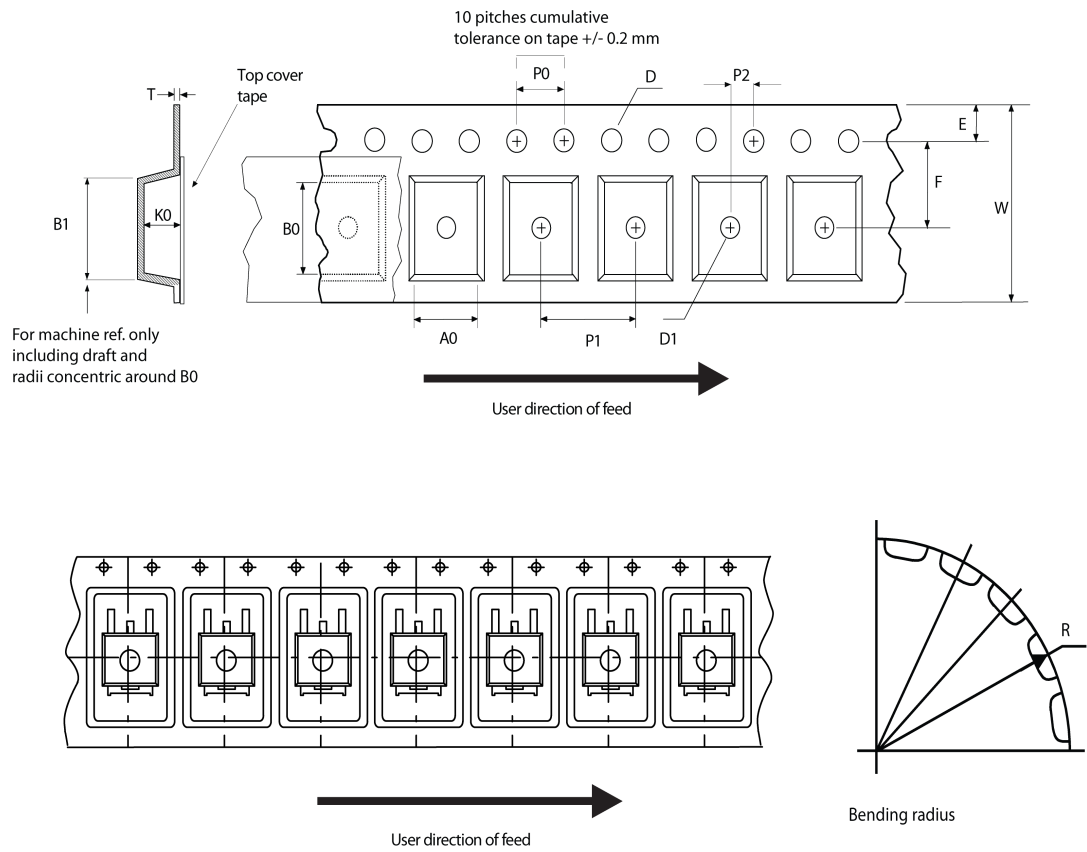
7012510_Rev_13_B

Table 9. TO-220FP package mechanical data

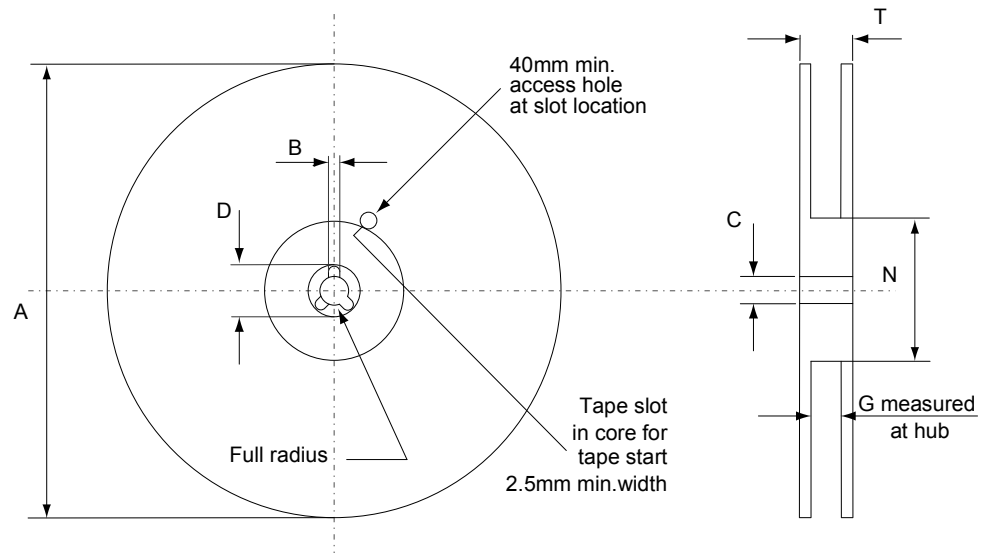
| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| B | 2.50 | | 2.70 |
| D | 2.50 | | 2.75 |
| E | 0.45 | | 0.70 |
| F | 0.75 | | 1.00 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.70 |
| G | 4.95 | | 5.20 |
| G1 | 2.40 | | 2.70 |
| H | 10.00 | | 10.40 |
| 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 D²PAK packing information

Figure 23. D²PAK tape outline



AM08852v1

Figure 24. D²PAK reel outline


AM06038v1

Table 10. 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 | Base quantity Bulk quantity | | | |
| P1 | 11.9 | 12.1 | | | | 1000 |
| P2 | 1.9 | 2.1 | | | | 1000 |
| R | 50 | | | | | |
| T | 0.25 | 0.35 | | | | |
| W | 23.7 | 24.3 | | | | |

5 Ordering information

Table 11. Order codes

| Order codes | Marking | Package | Packing |
|-------------|-----------|--------------------|---------------|
| STB12NM50T4 | B12NM50 | D ² PAK | Tape and reel |
| STP12NM50 | P12NM50 | TO-220 | Tube |
| STP12NM50FP | P12NM50FP | TO-220FP | Tube |

Revision history

Table 12. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 14-Mar-2004 | 8 | Preliminary version |
| 15-Feb-2006 | 9 | New voltage value on first page at t_{jmax} . |
| 05-Apr-2006 | 10 | Inserted ecopack indication |
| 27-Jul-2006 | 11 | New template, no content change |
| 22-Oct-2020 | 12 | <p>The part number STB12NM50-1 have been moved to a separate datasheet and the document has been updated accordingly.</p> <p>Updated cover page.</p> <p>Updated Section 1 Electrical ratings and Section 2 Electrical characteristics.</p> <p>Added Section 5 Ordering information.</p> <p>Minor text changes.</p> |

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