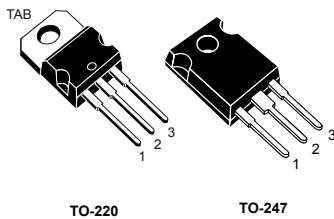
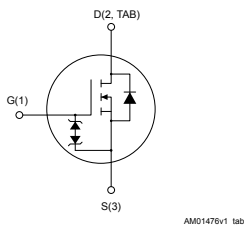


N-channel 600 V, 0.085 Ω typ., 30 A MDmesh DM6 Power MOSFETs in TO-220 and TO-247 packages



TO-220

TO-247



Features

| Order code | V_{DS} | $R_{DS(on)}$ max. | I_D |
|-------------|----------|-------------------|-------|
| STP45N60DM6 | 600 V | 0.099 Ω | 30 A |
| STW45N60DM6 | | | |

- Fast-recovery body diode
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

These high-voltage N-channel Power MOSFETs are part of the MDmesh DM6 fast-recovery diode series. Compared with the previous MDmesh fast generation, DM6 combines very low recovery charge (Q_{rr}), recovery time (t_{rr}) and excellent improvement in $R_{DS(on)}$ per area with one of the most effective switching behaviors available in the market for the most demanding high-efficiency bridge topologies and ZVS phase-shift converters.

Product status links

[STP45N60DM6](#)
[STW45N60DM6](#)

Product summary

| | |
|------------|-------------|
| Order code | STP45N60DM6 |
| Marking | 45N60DM6 |
| Package | TO-220 |
| Packing | Tube |
| Order code | STW45N60DM6 |
| Marking | 45N60DM6 |
| Package | TO-247 |
| Packing | Tube |

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------------------|
| V_{GS} | Gate-source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 30 | A |
| | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 19 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 95 | A |
| P_{TOT} | Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 210 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 100 | V/ns |
| $di/dt^{(2)}$ | Peak diode recovery current slope | 1000 | A/ μs |
| $dv/dt^{(3)}$ | MOSFET dv/dt ruggedness | 100 | V/ns |
| T_{stg} | Storage temperature range | -55 to 150 | $^\circ\text{C}$ |
| T_J | Operating junction temperature range | | |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 30\text{ A}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$
3. $V_{DS} \leq 480\text{ V}$

Table 2. Thermal data

| Symbol | Parameter | Value | | Unit |
|----------------|-------------------------------------|--------|--------|--------------------|
| | | TO-220 | TO-247 | |
| $R_{thj-case}$ | Thermal resistance junction-case | 0.6 | | $^\circ\text{C/W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 62.5 | 50 | $^\circ\text{C/W}$ |

Table 3. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T_{Jmax}) | 6 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$; $V_{DD} = 50\text{ V}$) | 630 | mJ |

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|---|------|-------|---------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$ | 600 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$ | | | 5 | μA |
| | | $V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ °C}^{(1)}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$ | | | ± 5 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 3.25 | 4 | 4.75 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}, I_D = 15\text{ A}$ | | 0.085 | 0.099 | 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 | $V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$ | - | 1920 | - | pF |
| C_{oss} | Output capacitance | | - | 120 | - | pF |
| C_{riss} | Reverse transfer capacitance | | - | 2 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}, V_{GS} = 0\text{ V}$ | - | 310 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}, I_D = 0\text{ A}$ | - | 1.5 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}, I_D = 30\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 16. Test circuit for gate charge behavior) | - | 44 | - | nC |
| Q_{gs} | Gate-source charge | | - | 10 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 25 | - | nC |

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 | $V_{DD} = 300\text{ V}, I_D = 15\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 17. Test circuit for inductive load switching and diode recovery times) and Figure 20. Switching time waveform | - | 15 | - | ns |
| t_r | Rise time | | - | 5.3 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 50 | - | ns |
| t_f | Fall time | | - | 7.3 | - | ns |

Table 7. Source-drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 30 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 95 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = 30\text{ A}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 30\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see)Figure 17. Test circuit for inductive load switching and diode recovery times | - | 110 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 0.5 | | μC |
| I_{RRM} | Reverse recovery current | | - | 9 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 30\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see)Figure 17. Test circuit for inductive load switching and diode recovery times | - | 215 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 2 | | μC |
| I_{RRM} | Reverse recovery current | | - | 17 | | 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 TO-220

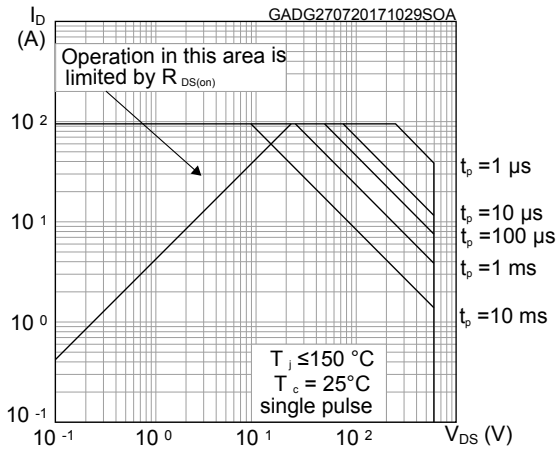


Figure 2. Thermal impedance for TO-220

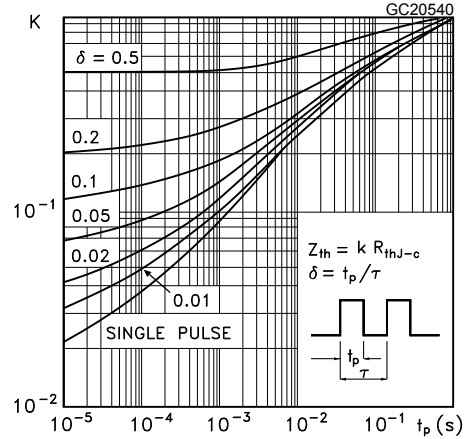


Figure 3. Safe operating area for TO-247

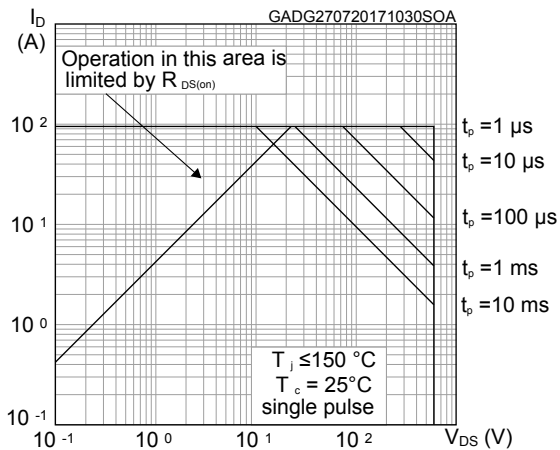


Figure 4. Thermal impedance for TO-247

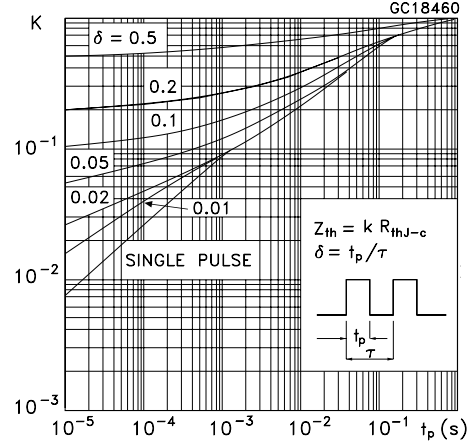


Figure 5. Output characteristics

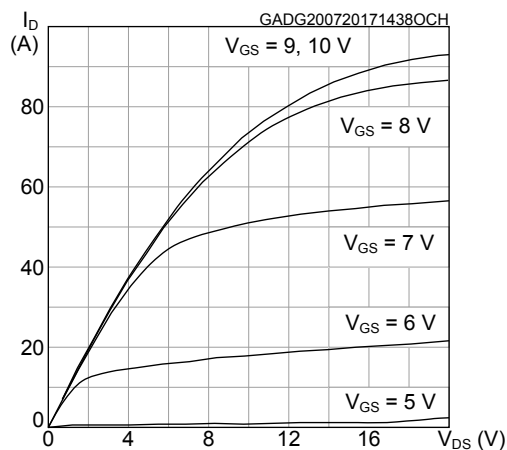


Figure 6. Transfer characteristics

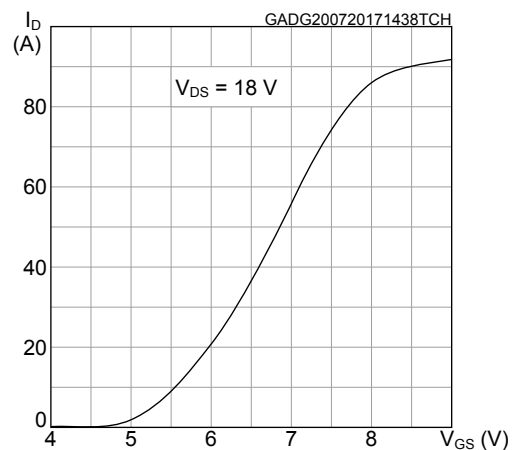


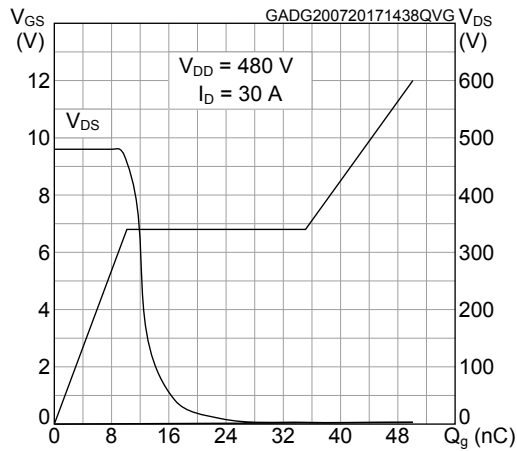
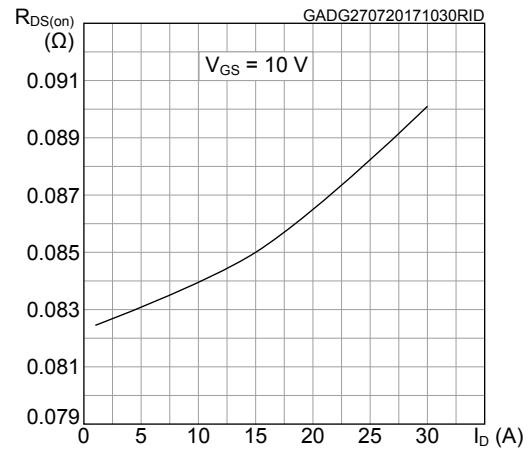
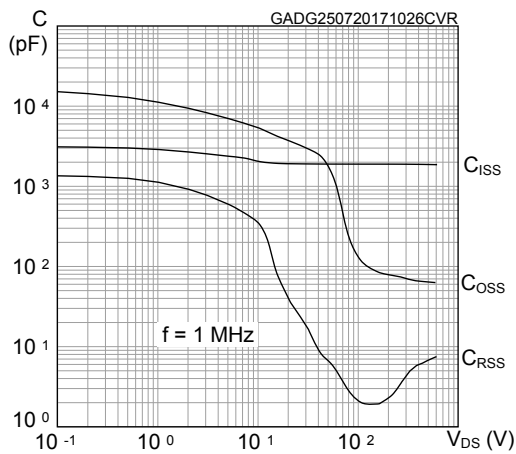
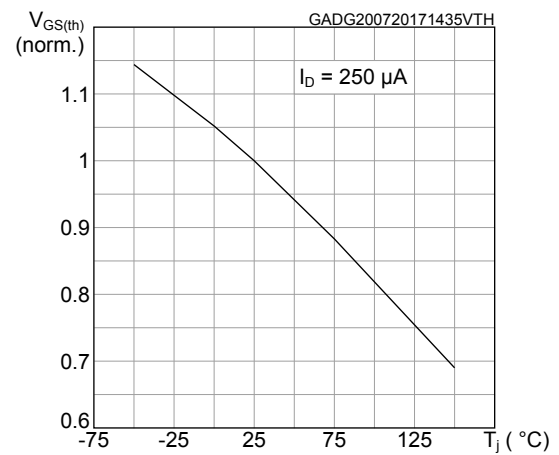
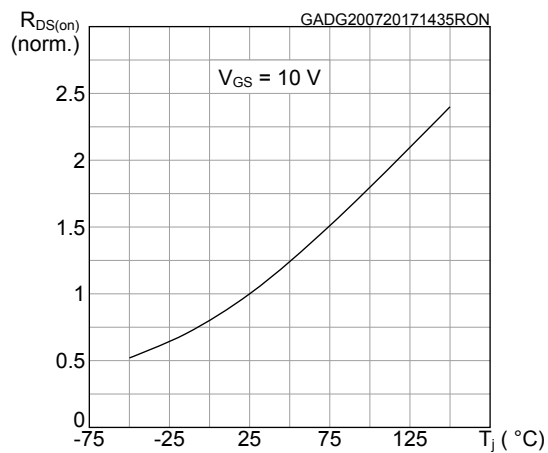
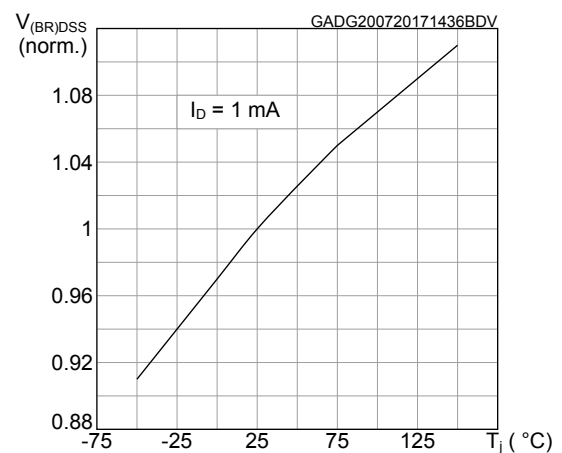
Figure 7. Gate charge vs gate-source voltage

Figure 8. Static drain-source on-resistance

Figure 9. Capacitance variations

Figure 10. Normalized gate threshold voltage vs temperature

Figure 11. Normalized on-resistance vs temperature

Figure 12. Normalized V(BR)DSS vs temperature


Figure 13. Source-drain diode forward characteristics

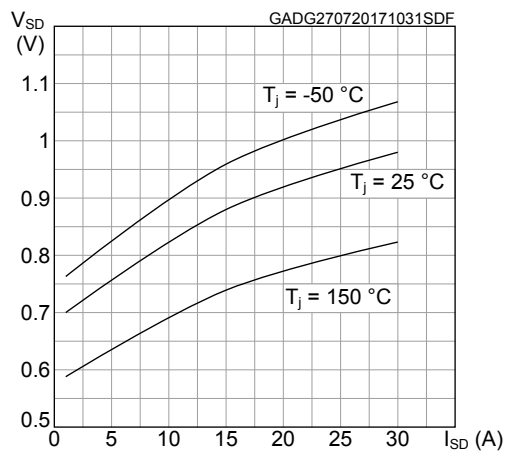
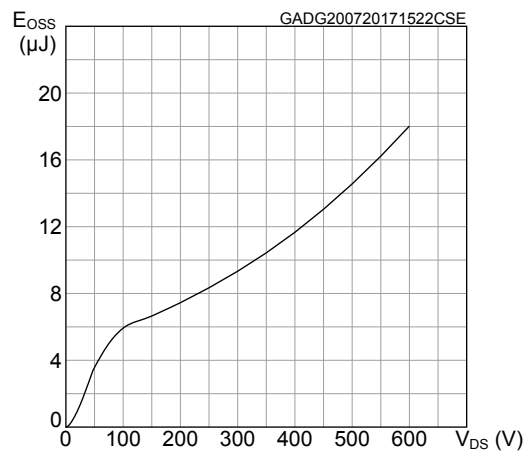
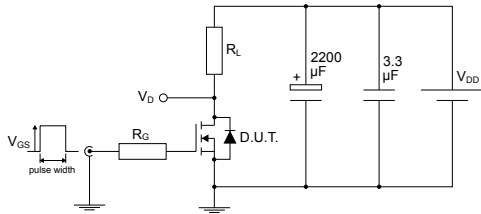


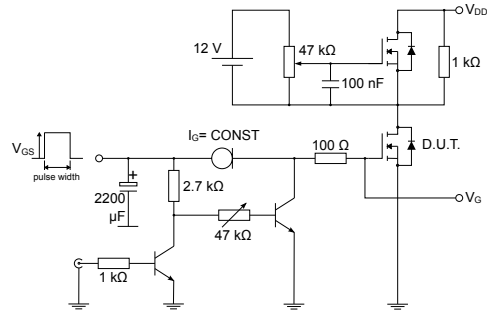
Figure 14. Output capacitance stored energy



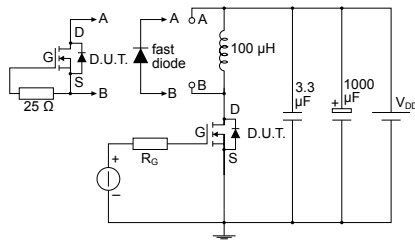
3 Test circuits

Figure 15. Test circuit for resistive load switching times


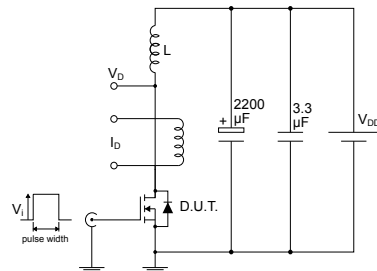
AM01468v1

Figure 16. Test circuit for gate charge behavior


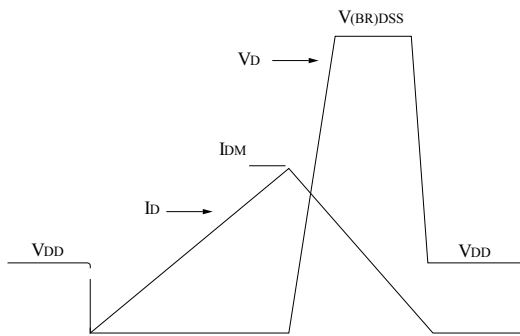
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Figure 17. Test circuit for inductive load switching and diode recovery times


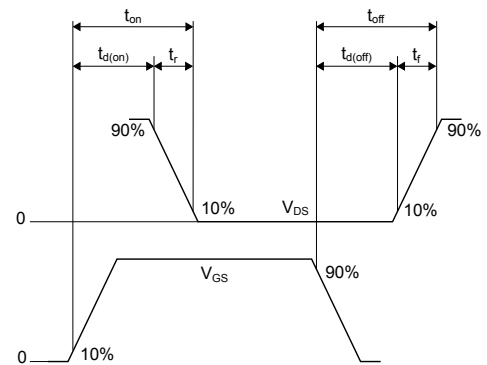
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Figure 18. Unclamped inductive load test circuit


AM01471v1

Figure 19. Unclamped inductive waveform


AM01472v1

Figure 20. Switching time waveform


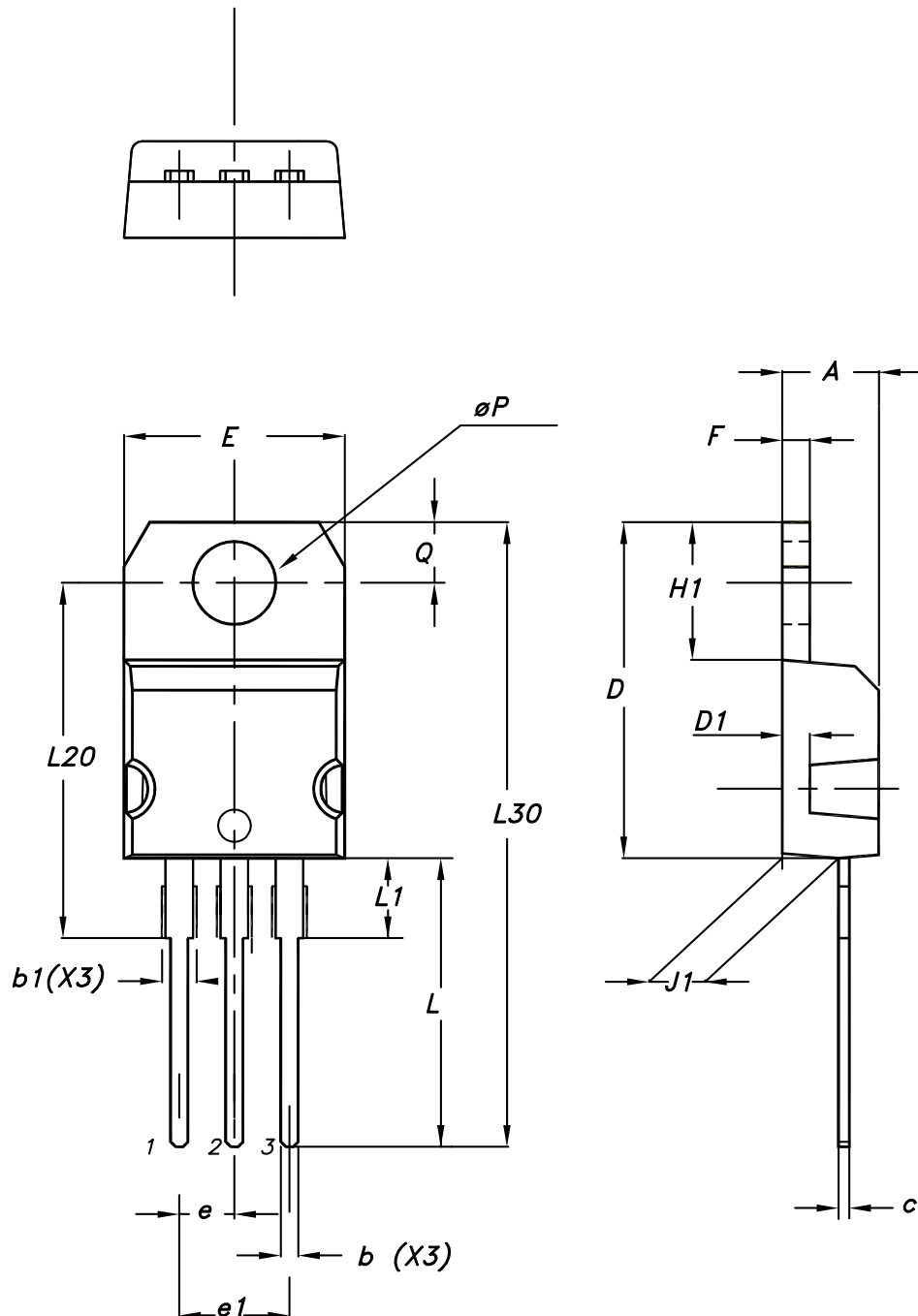
AM01473v1

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 TO-220 type A package information

Figure 21. TO-220 type A package outline



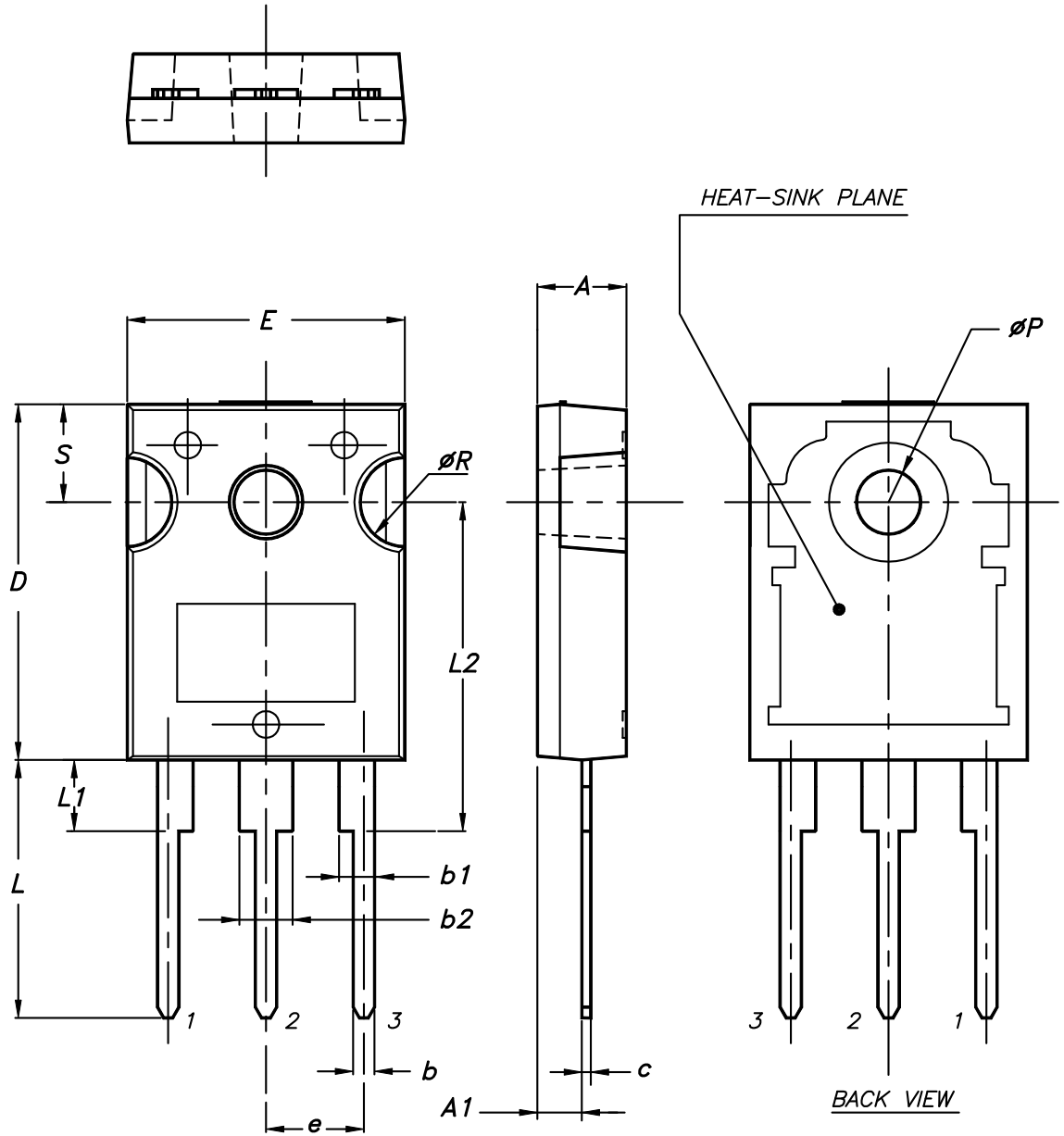
0015988_typeA_Rev_23

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 |

4.2 TO-247 package information

Figure 22. TO-247 package outline



0075325_9

Table 9. TO-247 package 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 | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 27-May-2016 | 1 | First release. |
| 01-Aug-2017 | 2 | Updated title and in cover page. Updated <i>Section 1: "Electrical ratings"</i> and <i>Section 2: "Electrical characteristics"</i> . Added <i>Section 2.1: "Electrical characteristics (curves)"</i> . Document status promoted from preliminary to production data. Minor text changes. |
| 03-Jul-2020 | 3 | Modified Table 1. Absolute maximum ratings . Minor text changes. |

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