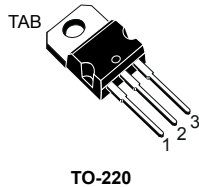
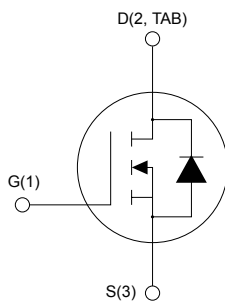


N-channel 600 V, 370 mΩ typ., 10 A FDmesh II Power MOSFET in a TO-220 package



TO-220



AM01475v1_noZen


Product status link
[STP11NM60ND](#)
Product summary

| | |
|-------------------|-------------|
| Order code | STP11NM60ND |
| Marking | 11NM60ND |
| Package | TO-220 |
| Packing | Tube |

Features

| Order code | V_{DS} at T_J max. | $R_{DS(on)}$ max. | I_D |
|-------------|------------------------|-------------------|-------|
| STP11NM60ND | 650 V | 450 mΩ | 10 A |

- Fast-recovery body diode
- Low gate charge and input capacitance
- Low on-resistance $R_{DS(on)}$
- 100% avalanche tested
- High dv/dt ruggedness

Applications

- Switching applications

Description

This FDmesh II Power MOSFET with fast-recovery body diode is produced using MDmesh II technology. Utilizing a new strip-layout vertical structure, this device features low on-resistance and superior switching performance. It is ideal for bridge topologies and ZVS phase-shift converters.

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------|
| V_{DS} | Drain-source voltage | 600 | V |
| V_{GS} | Gate-source voltage | ±25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ °C}$ | 10 | A |
| | Drain current (continuous) at $T_C = 100\text{ °C}$ | 6.3 | |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 40 | A |
| P_{TOT} | Total power dissipation at $T_C = 25\text{ °C}$ | 90 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 40 | V/ns |
| T_{stg} | Storage temperature range | -55 to 150 | °C |
| T_J | Maximum operating junction temperature | 150 | °C |

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 10\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 2. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|---|-------|------|
| R_{thJC} | Thermal resistance, junction-to-case | 1.38 | °C/W |
| R_{thJA} | Thermal resistance, junction-to-ambient | 62.5 | °C/W |

Table 3. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AS} | Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max.) | 3.5 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_J = 25\text{ °C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$) | 200 | 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 |
| $dv/dt^{(1)}$ | Drain-source voltage slope | $V_{DD} = 480\text{ V}$, $I_D = 10\text{ A}$, $V_{GS} = 10\text{ V}$ | | 45 | | V/ns |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}^{(2)}$ | | | 100 | |
| 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 | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 5\text{ A}$ | | 370 | 450 | m Ω |

1. Value measured at turn off under inductive load.
2. Specified by design, not tested in production.

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|--|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 850 | - | pF |
| C_{oss} | Output capacitance | | - | 44 | - | pF |
| C_{rSS} | Reverse transfer capacitance | | - | 5 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }480\text{ V}$ | - | 130 | - | pF |
| R_G | Gate input resistance | $f = 1\text{ MHz}$, $I_D = 0\text{ A}$ | - | 3.7 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}$, $I_D = 10\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 13. Test circuit for gate charge behavior) | - | 30 | - | nC |
| Q_{gs} | Gate-source charge | | - | 4 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 16 | - | 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 | $V_{DD} = 300\text{ V}$, $I_D = 10\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ | - | 16 | - | ns |
| t_r | Rise time | | - | 7 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform) | - | 50 | - | ns |
| t_f | Fall time | | - | 9 | - | ns |

Table 7. Source-drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 10 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 40 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 10\text{ A}$, $V_{GS} = 0\text{ V}$ | - | | 1.3 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 10\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, | - | 130 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 100\text{ V}$ | - | 0.69 | | μC |
| I_{RRM} | Reverse recovery current | (see Figure 14. Test circuit for inductive load switching and diode recovery times) | - | 11 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 10\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, | - | 200 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ | - | 1.2 | | μC |
| I_{RRM} | Reverse recovery current | (see Figure 14. Test circuit for inductive load switching and diode recovery times) | - | 12 | | 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

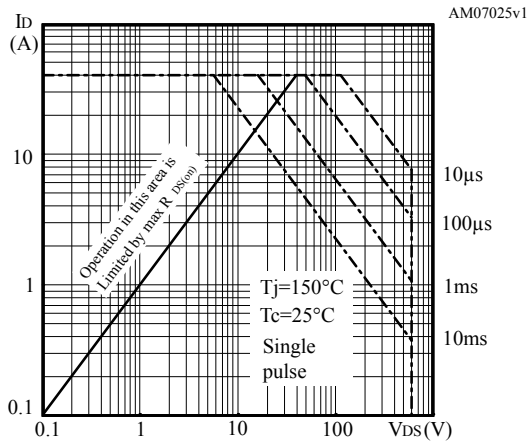


Figure 2. Normalized transient thermal impedance

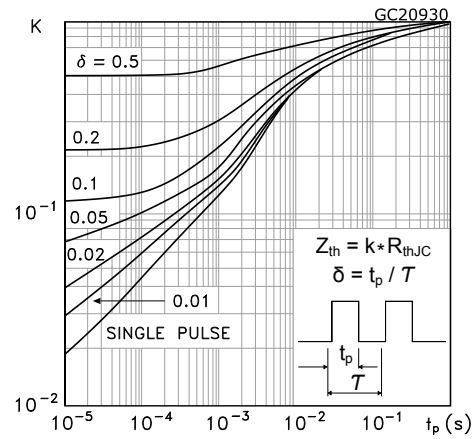


Figure 3. Typical drain-source on-resistance

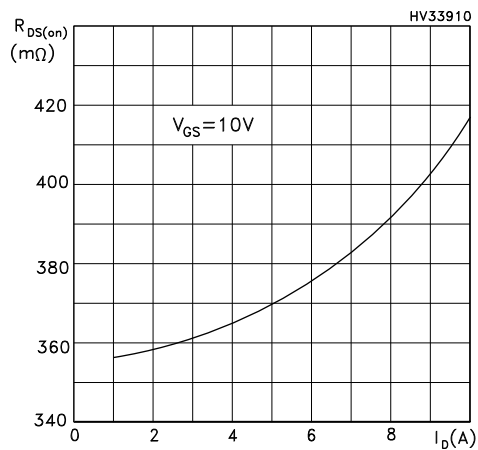


Figure 4. Typical output characteristics

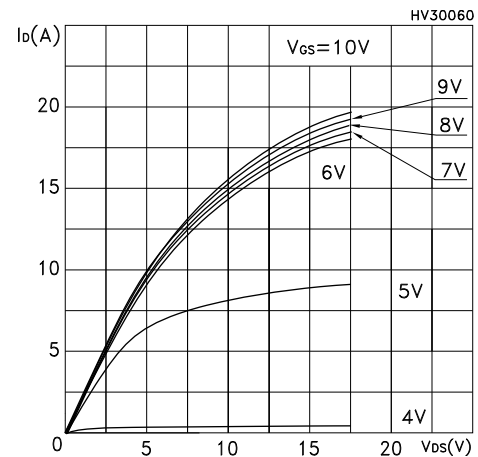


Figure 5. Typical transfer characteristics

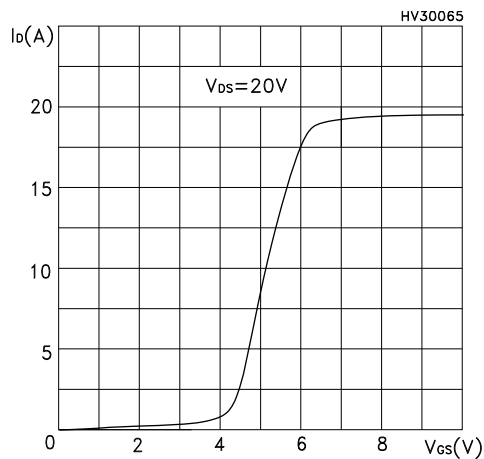


Figure 6. Normalized gate threshold vs temperature

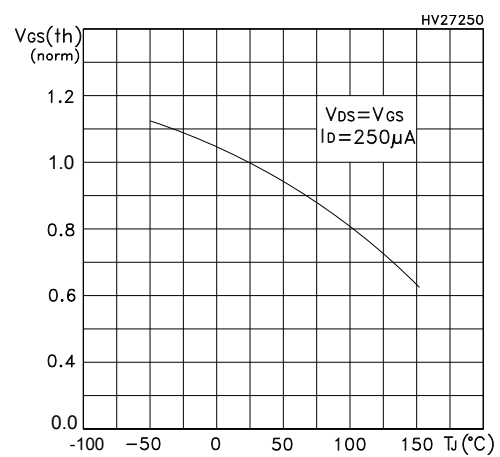


Figure 7. Normalized breakdown voltage vs temperature

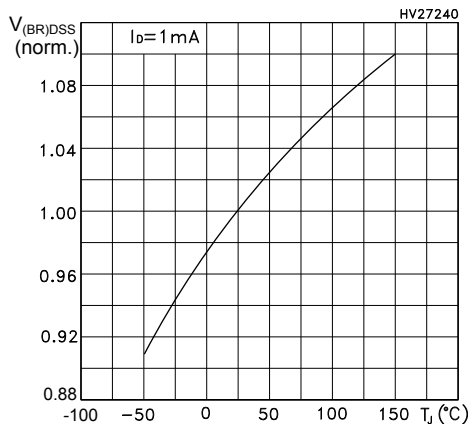


Figure 8. Normalized on-resistance vs temperature

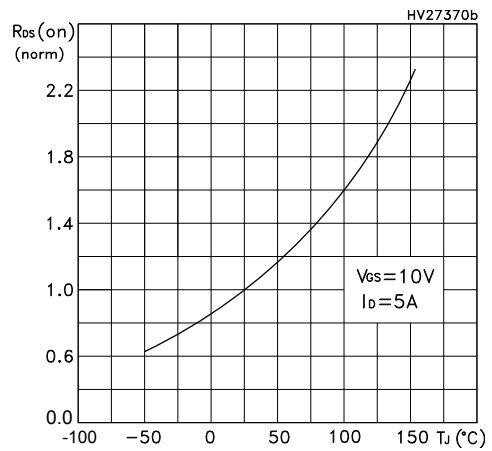


Figure 9. Typical gate charge characteristics

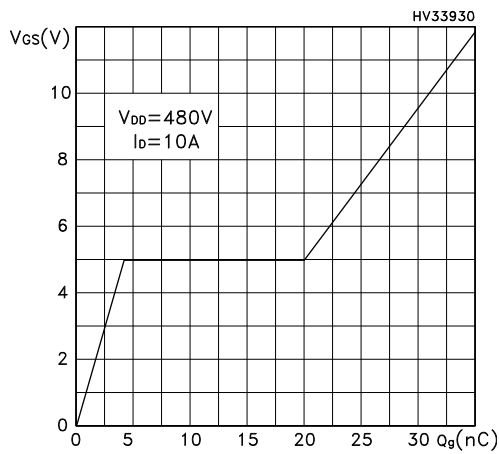


Figure 10. Typical capacitance characteristics

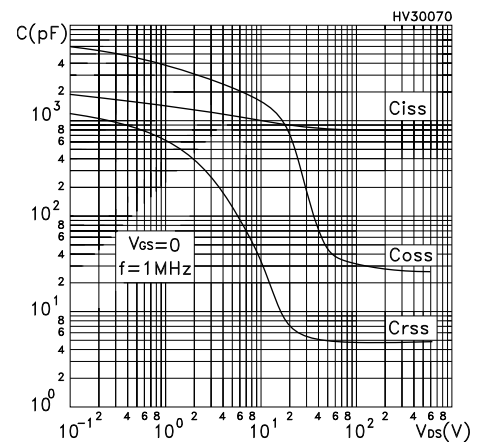
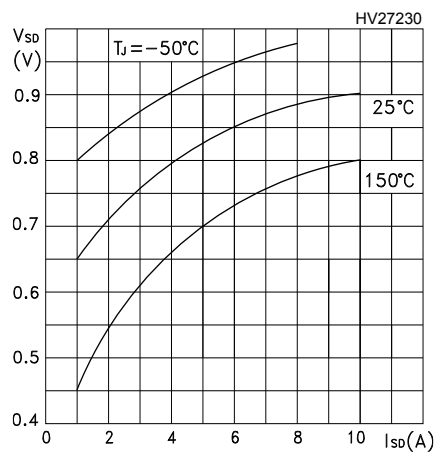
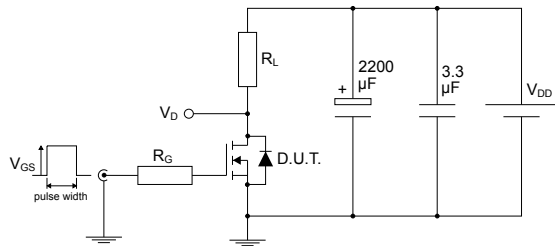


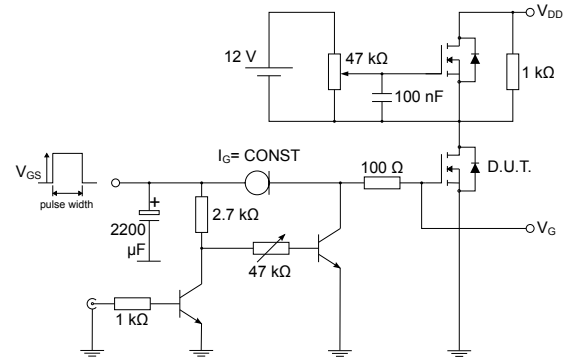
Figure 11. Typical reverse diode forward characteristics



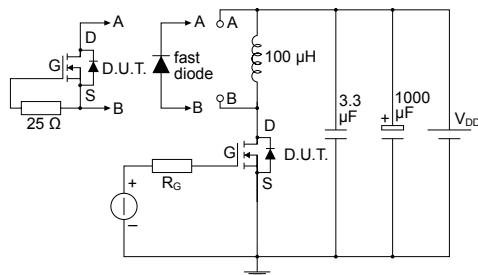
3 Test circuits

Figure 12. Test circuit for resistive load switching times


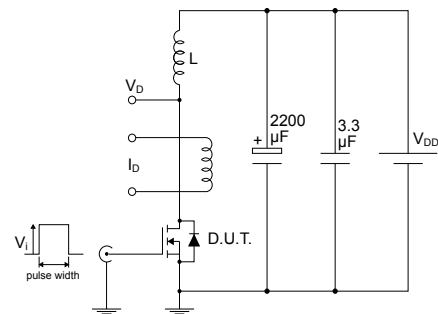
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Figure 13. Test circuit for gate charge behavior


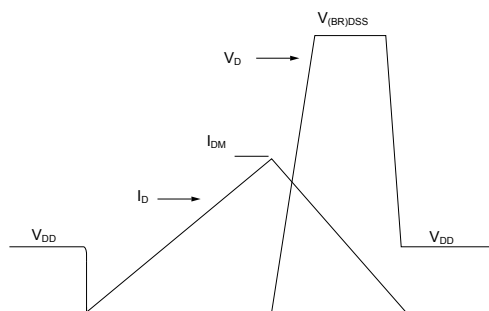
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Figure 14. Test circuit for inductive load switching and diode recovery times


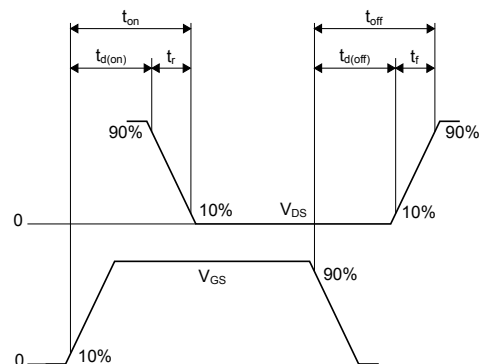
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Figure 15. Unclamped inductive load test circuit


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Figure 16. Unclamped inductive waveform


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Figure 17. Switching time waveform


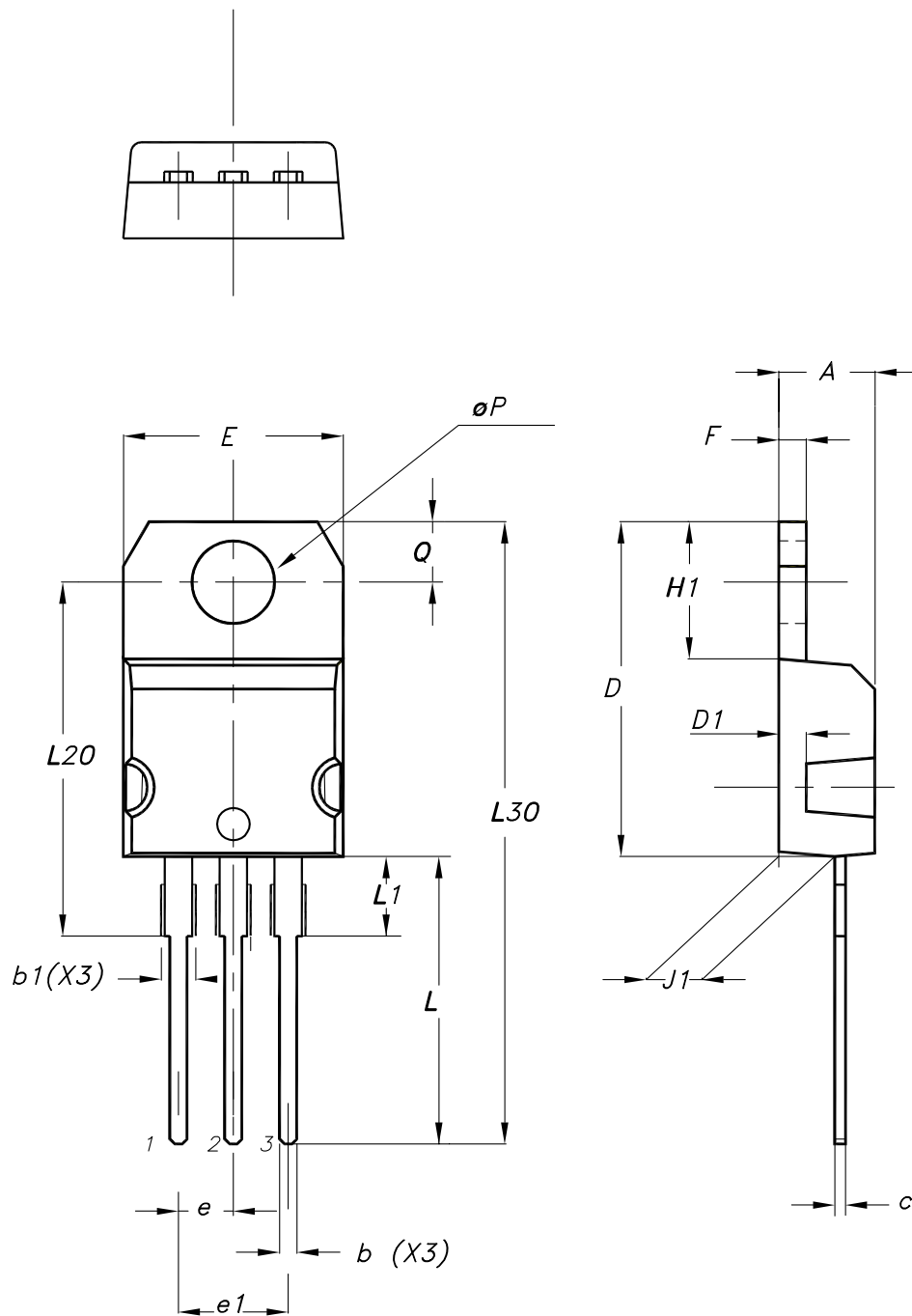
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4 Package information

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 TO-220 type A package information

Figure 18. 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 |

Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 21-Jun-2023 | 1 | First release. Part number previously included in datasheet DS5797. |

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