

N-channel 600 V, 0.255 Ω typ., 13 A MDmesh II Plus™ low Q_g Power MOSFET in D²PAK, TO-220 and TO-247 packages

Datasheet - production data

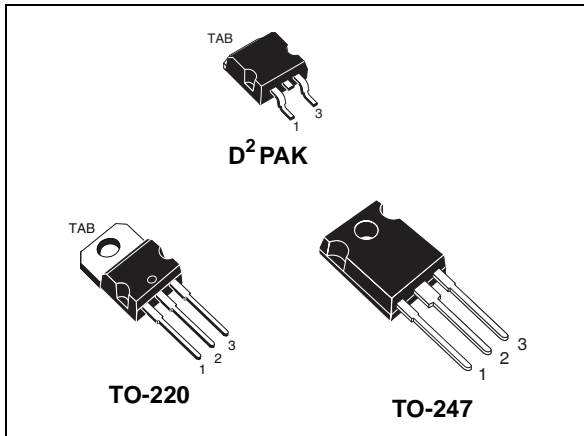
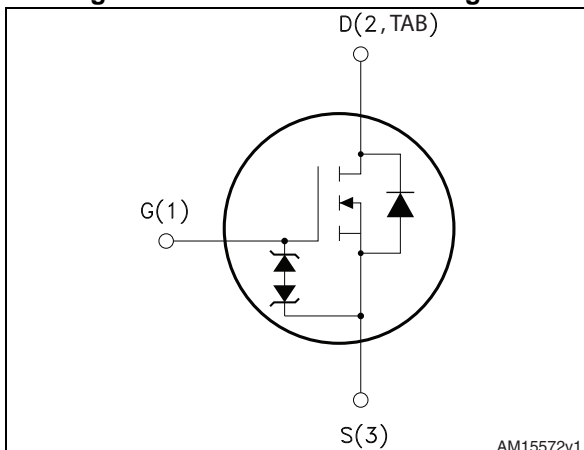


Figure 1. Internal schematic diagram



Features

| Order codes | $V_{DS} @ T_{Jmax}$ | $R_{DS(on) max}$ | I_D |
|-------------|---------------------|------------------|-------|
| STB18N60M2 | 650 V | 0.28 Ω | 13 A |
| STP18N60M2 | | | |
| STW18N60M2 | | | |

- Extremely low gate charge
- Lower $R_{DS(on)}$ x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- LLC converters, resonant converters

Description

These devices are N-channel Power MOSFETs developed using a new generation of MDmesh™ technology: MDmesh II Plus™ low Q_g . These revolutionary Power MOSFETs associate a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. They are therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|---------------|
| STB18N60M2 | 18N60M2 | D ² PAK | Tape and reel |
| STP18N60M2 | | TO-220 | Tube |
| STW18N60M2 | | TO-247 | |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|-------------|------------------|
| V_{GS} | Gate-source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 13 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 8 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 52 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 110 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | V/ns |
| $dv/dt^{(3)}$ | MOSFET dv/dt ruggedness | 50 | V/ns |
| T_{stg} | Storage temperature | - 55 to 150 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | | |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 13\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD}=400\text{ V}$.
3. $V_{DS} \leq 480\text{ V}$

Table 3. Thermal data

| Symbol | Parameter | Value | | | Unit |
|---------------------|---|--------------------|--------|--------|---------------------------|
| | | D ² PAK | TO-220 | TO-247 | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.14 | | | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | | | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max | 30 | | | $^\circ\text{C}/\text{W}$ |

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

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|---|-------|------|
| I_{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax}) | 3 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j=25\text{ }^\circ\text{C}$, $I_D = I_{AR}$; $V_{DD}=50$) | 135 | mJ |

2 Electrical characteristics

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

Table 5. On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|-------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 600 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 600\text{ V}$ | | | 1 | μA |
| | | $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | 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 | $V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$ | | 0.255 | 0.28 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|---|------|-------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 791 | - | pF |
| C_{oss} | Output capacitance | | - | 40 | - | pF |
| C_{riss} | Reverse transfer capacitance | | - | 5.6 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0$ | - | 164.5 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$, $I_D = 0$ | - | 5.6 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 16) | - | 21.5 | - | nC |
| Q_{gs} | Gate-source charge | | - | 3.2 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 11.3 | - | 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 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------|---------------------|--|------|------|------|------|
| $t_d(on)$ | Turn-on delay time | $V_{DD} = 300\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15 and Figure 20) | - | 12 | - | ns |
| t_r | Rise time | | - | 9 | - | ns |
| $t_d(off)$ | Turn-off delay time | | - | 47 | - | ns |
| t_f | Fall time | | - | 10.6 | - | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 13 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 52 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 13 \text{ A}$, $V_{GS} = 0$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 13 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see Figure 17) | - | 305 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 3.3 | | μC |
| I_{RRM} | Reverse recovery current | | - | 22 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 13 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 17) | - | 417 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 4.6 | | μC |
| I_{RRM} | Reverse recovery current | | - | 22 | | A |

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for D²PAK and TO-220

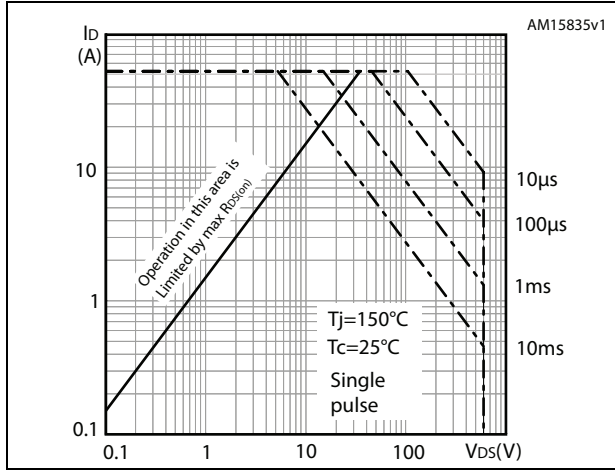


Figure 3. Thermal impedance for D²PAK, TO-220 and TO-247

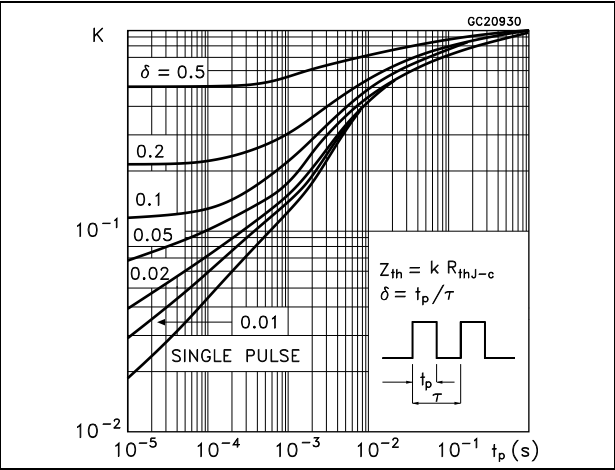


Figure 4. Safe operating area for TO-247

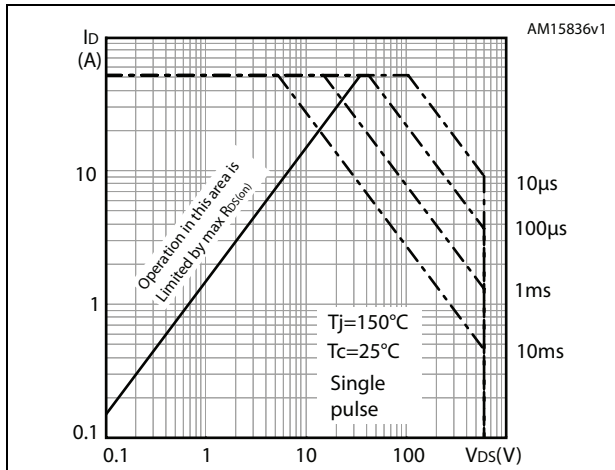


Figure 5. Output characteristics

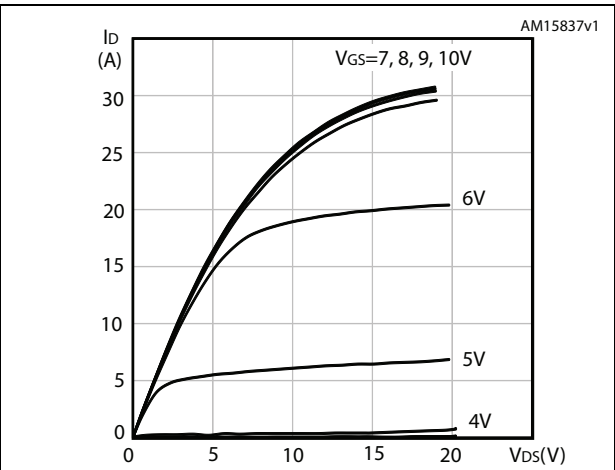


Figure 6. Transfer characteristics

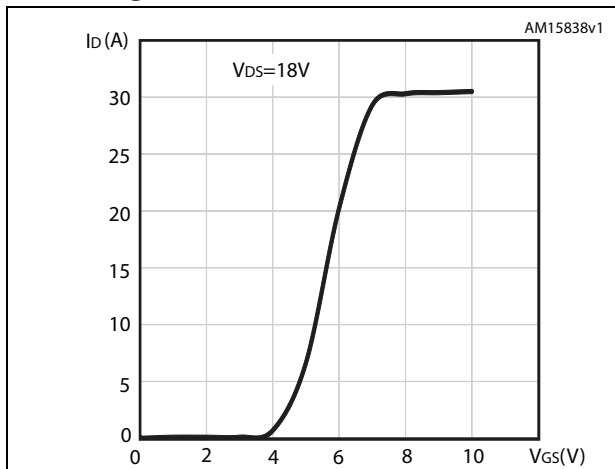


Figure 7. Gate charge vs gate-source voltage

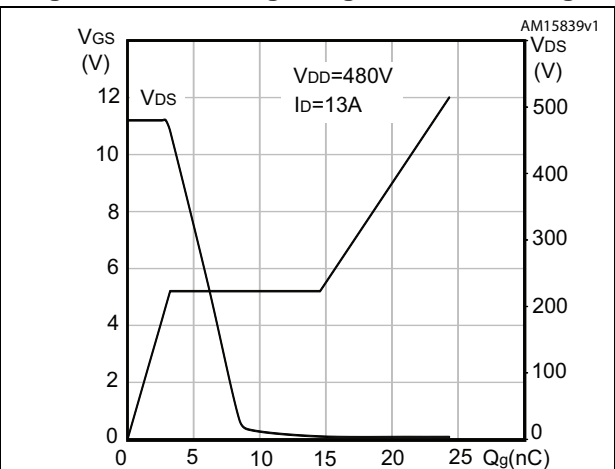


Figure 8. Static drain-source on-resistance

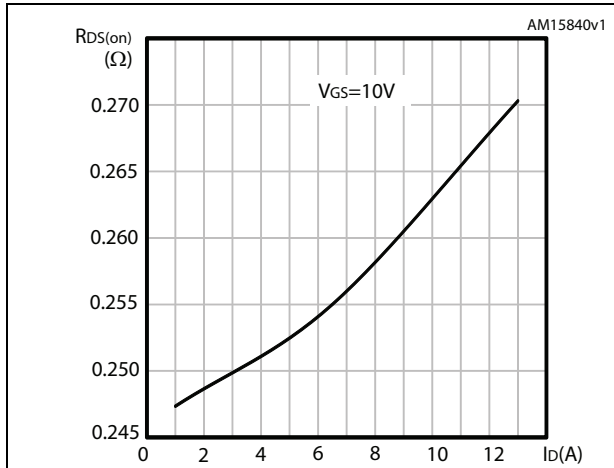


Figure 9. Capacitance variations

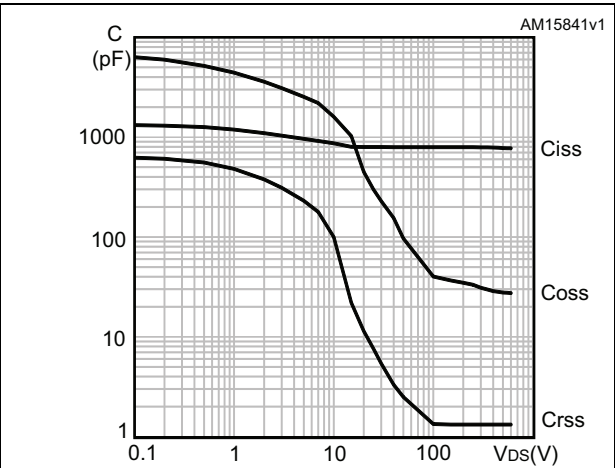


Figure 10. Normalized gate threshold voltage vs. temperature

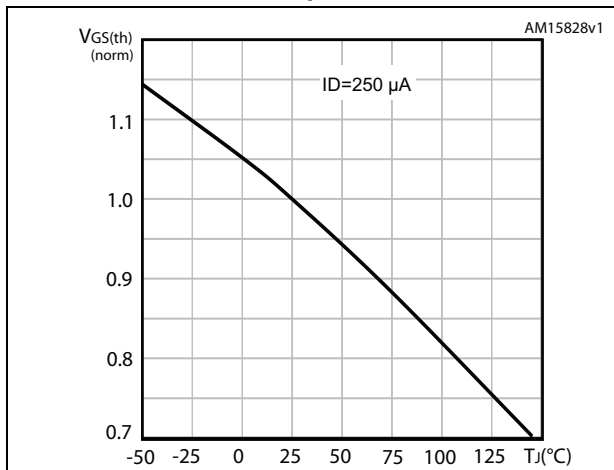


Figure 11. Normalized on-resistance vs temperature

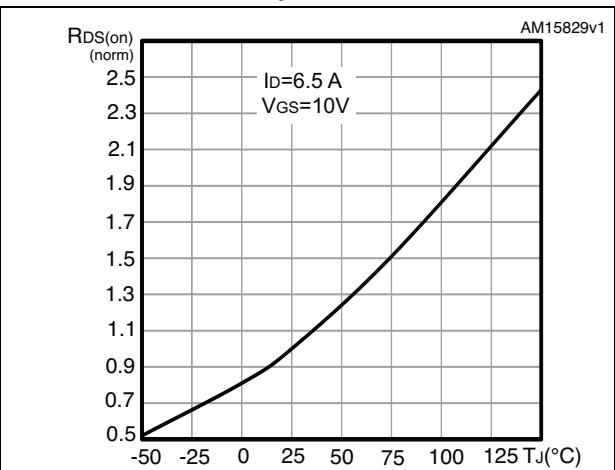


Figure 12. Source-drain diode forward characteristics

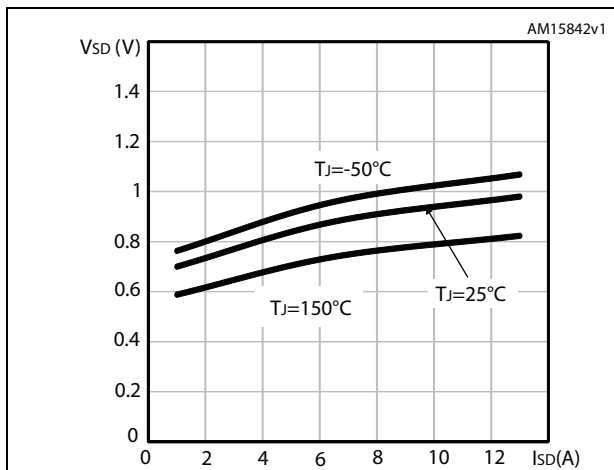


Figure 13. Normalized $V_{(BR)DSS}$ vs temperature

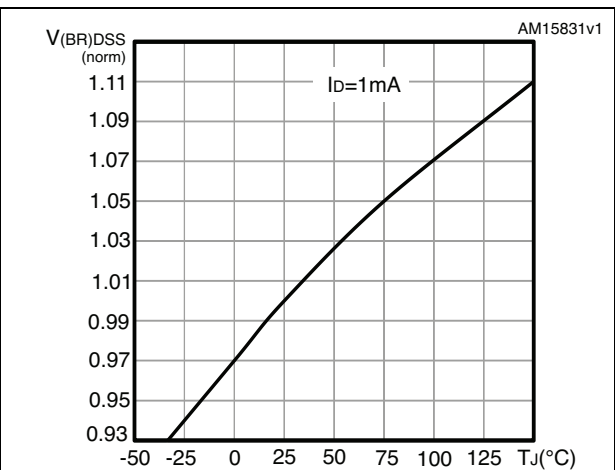
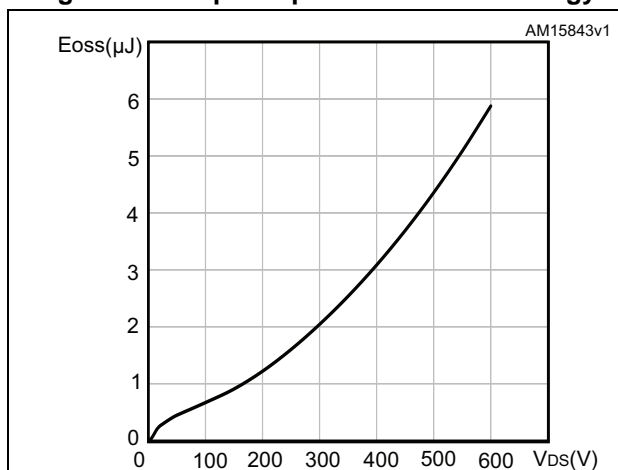


Figure 14. Output capacitance stored energy



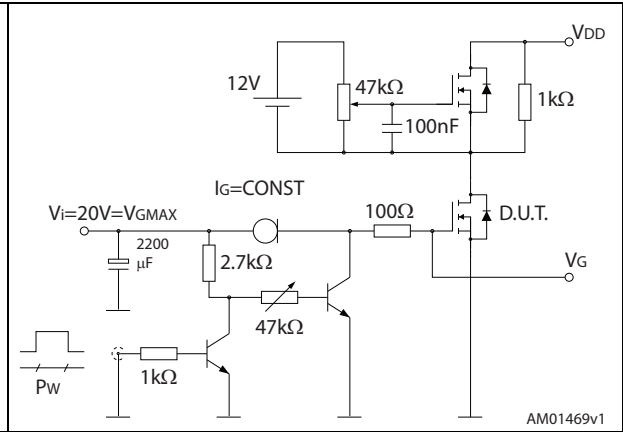
3 Test circuits

Figure 15. Switching times test circuit for resistive load



AM01468v1

Figure 16. Gate charge test circuit



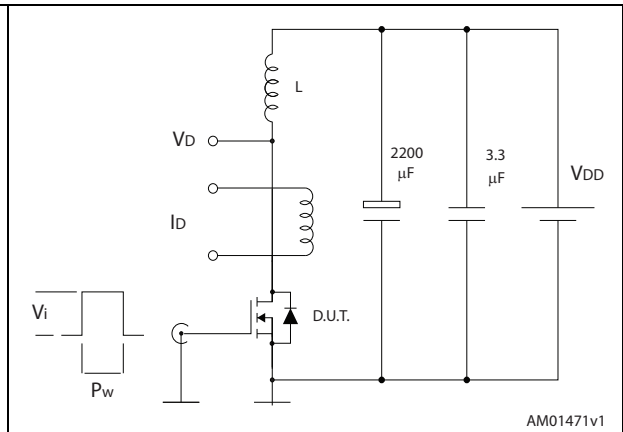
AM01469v1

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



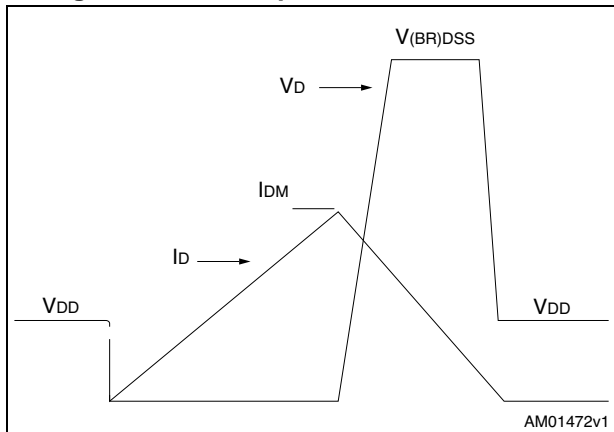
AM01470v1

Figure 18. Unclamped inductive load test circuit



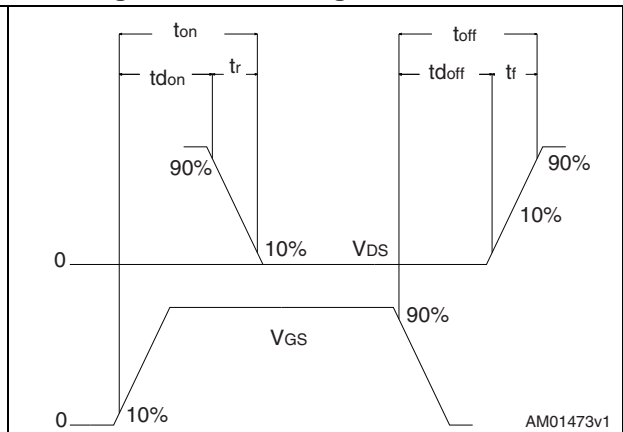
AM01471v1

Figure 19. Unclamped inductive waveform



AM01472v1

Figure 20. Switching time waveform



AM01473v1

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.

Figure 21. D²PAK (TO-263) drawing

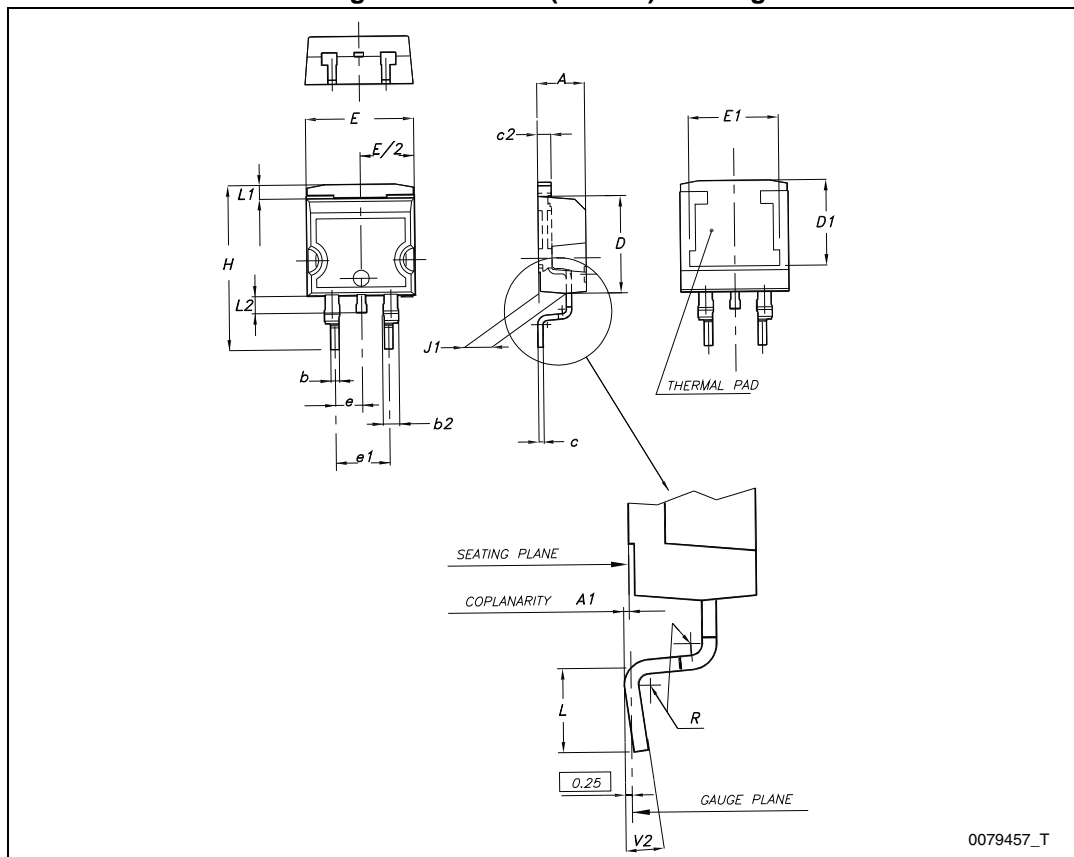
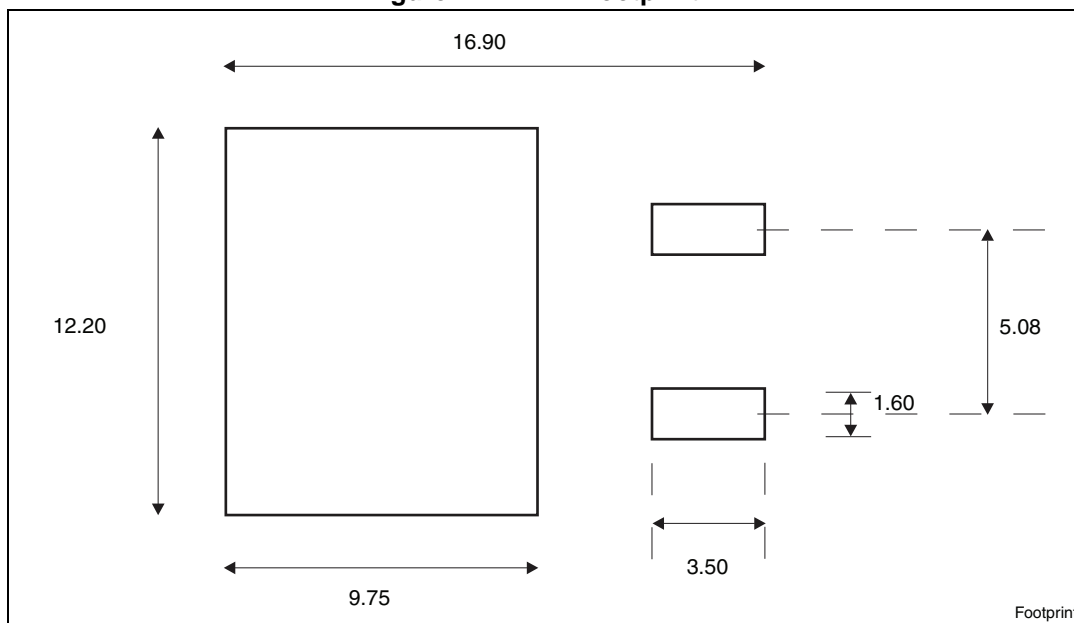


Table 9. D²PAK (TO-263) mechanical data

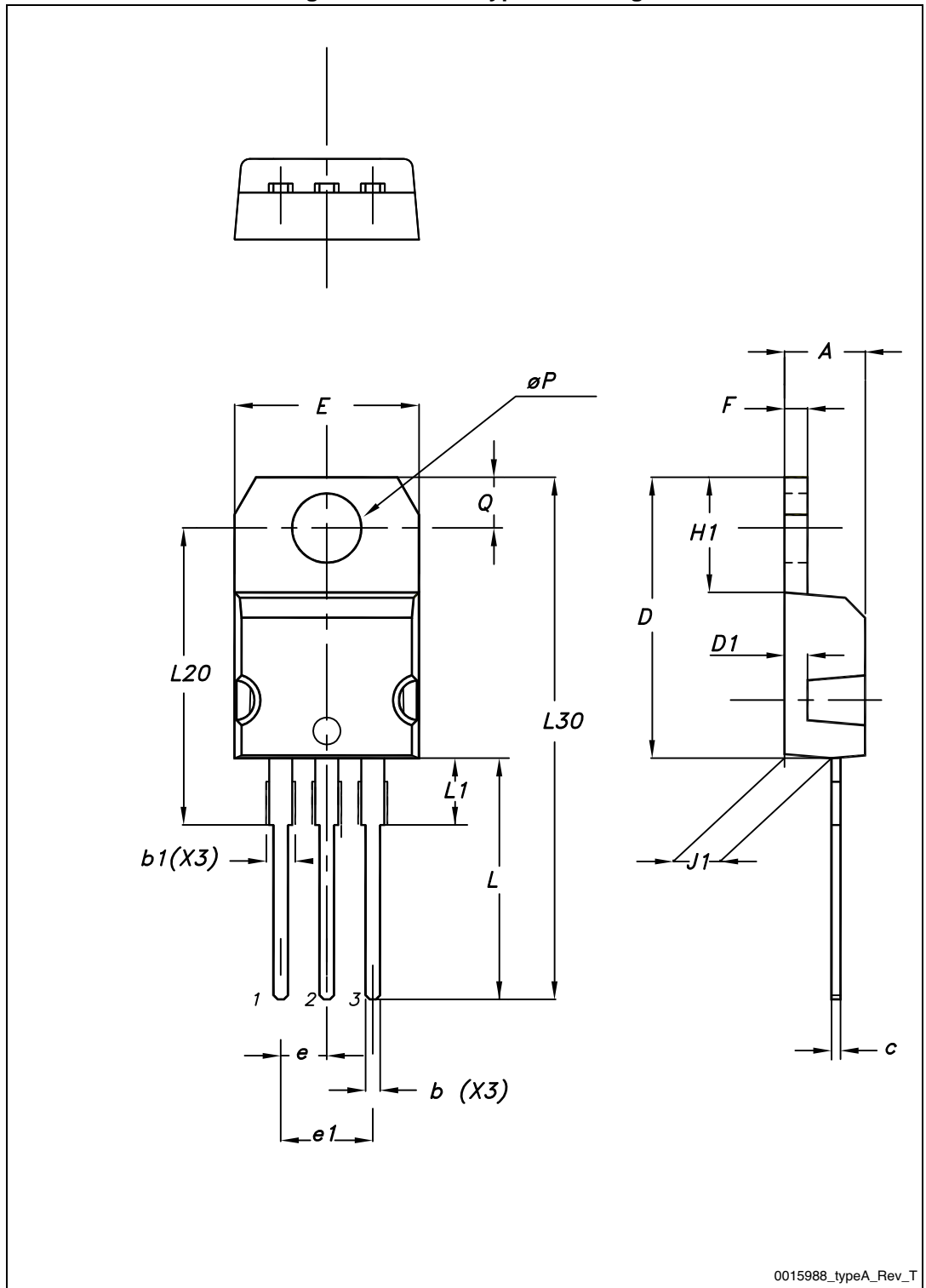
| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| A1 | 0.03 | | 0.23 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.45 | | 0.60 |
| c2 | 1.23 | | 1.36 |
| D | 8.95 | | 9.35 |
| D1 | 7.50 | | |
| E | 10 | | 10.40 |
| E1 | 8.50 | | |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.4 | |
| V2 | 0° | | 8° |

Figure 22. D²PAK footprint^(a)



a. All dimension are in millimeters

Figure 23. TO-220 type A drawing

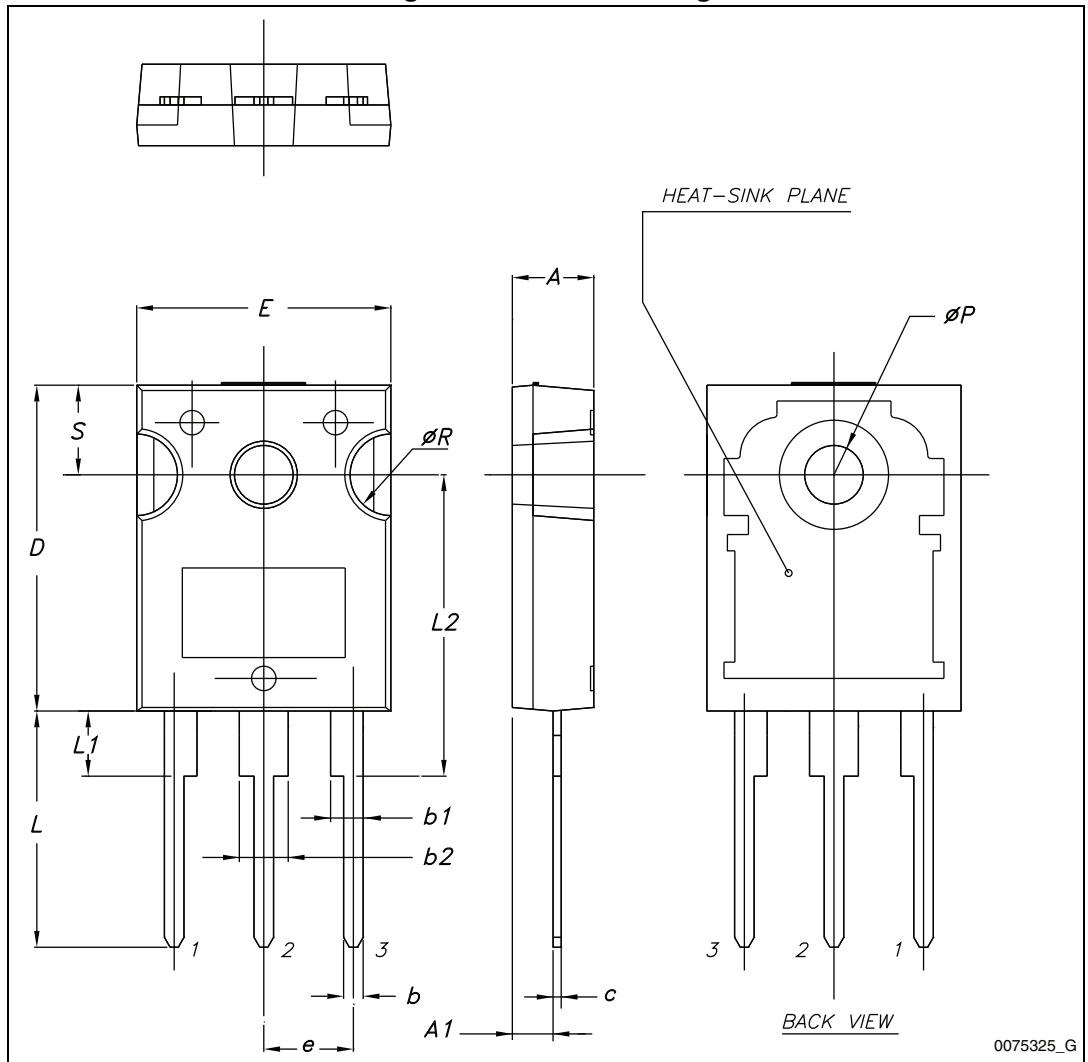


0015988_typeA_Rev_T

Table 10. TO-220 type A mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 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 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| ØP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

Figure 24. TO-247 drawing



0075325_G

Table 11. TO-247 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 |

5 Packaging mechanical data

Figure 25. Tape

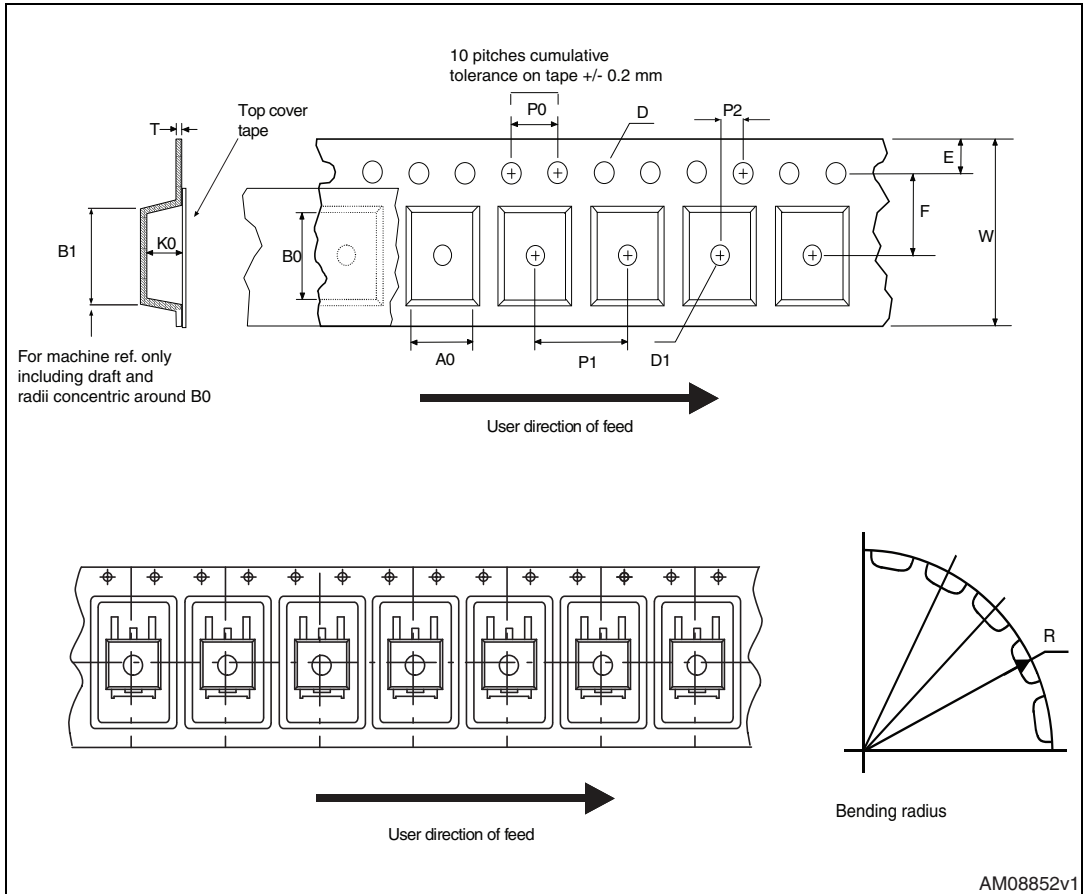


Figure 26. Reel

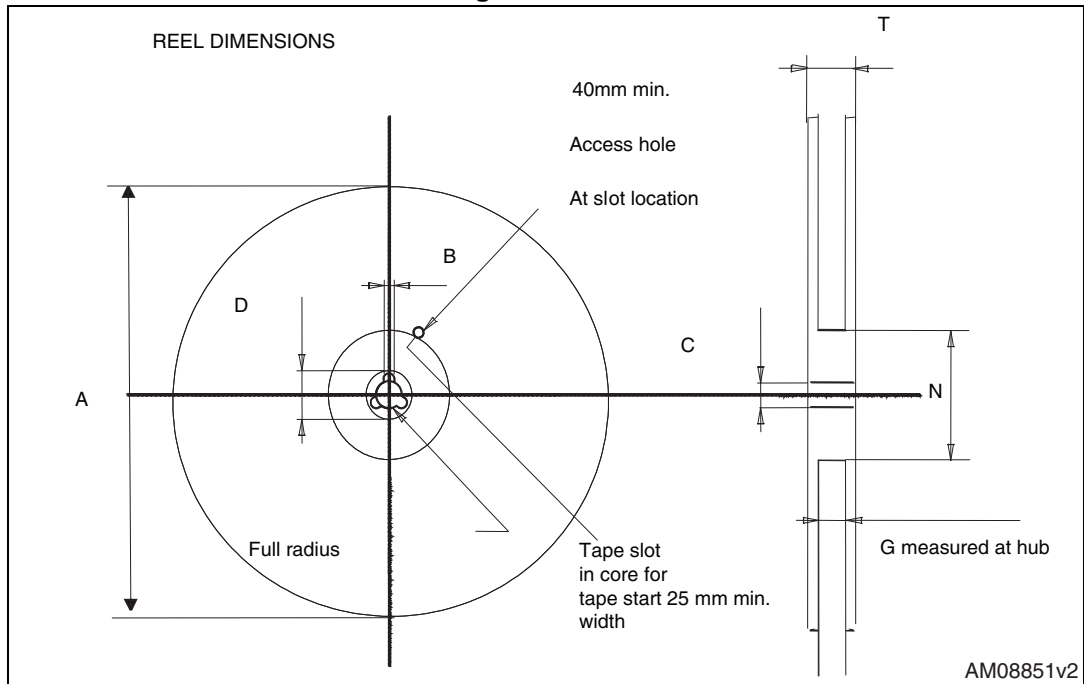


Table 12. D²PAK (TO-263) tape and reel mechanical data

| 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 | | | |
| P1 | 11.9 | 12.1 | Base qty | | 1000 |
| P2 | 1.9 | 2.1 | Bulk qty | | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

6 Revision history

Table 13. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 05-Jun-2013 | 1 | First release. |
| 28-Feb-2014 | 2 | <ul style="list-style-type: none">– Modified: note 1 in Table 2– $R_{thj-case}$ value in Table 3– Minor text changes |

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