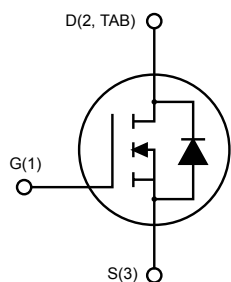
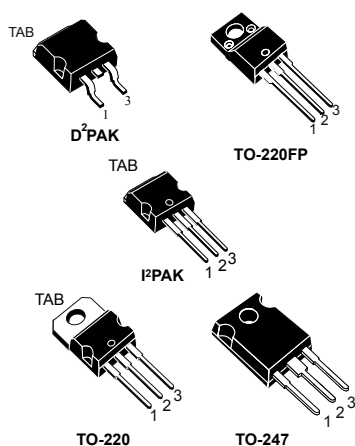


N-channel 650 V, 70 mΩ typ., 33 A, MDmesh M5 Power MOSFETs in D<sup>2</sup>PAK, TO-220FP, I<sup>2</sup>PAK, TO-220 and TO-247 packages



AM01475v1\_noZen



## Features

| Order codes | V <sub>DS</sub> @ T <sub>Jmax</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> | Package            |
|-------------|-------------------------------------|--------------------------|----------------|--------------------|
| STB42N65M5  | 710 V                               | 79 mΩ                    | 33 A           | D <sup>2</sup> PAK |
| STF42N65M5  |                                     |                          |                | TO-220FP           |
| STI42N65M5  |                                     |                          |                | I <sup>2</sup> PAK |
| STP42N65M5  |                                     |                          |                | TO-220             |
| STW42N65M5  |                                     |                          |                | TO-247             |

- Extremely low R<sub>DS(on)</sub>
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.

### Product status

STB42N65M5  
STF42N65M5  
STI42N65M5  
STP42N65M5  
STW42N65M5

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol                         | Parameter                                                                                                       | Value                                                     |                     | Unit |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|---------------------|------|
|                                |                                                                                                                 | D <sup>2</sup> PAK, I <sup>2</sup> PAK,<br>TO-220, TO-247 | TO-220FP            |      |
| V <sub>GS</sub>                | Gate-source voltage                                                                                             | ±25                                                       |                     | V    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 25 °C                                                            | 33                                                        | 33 <sup>(1)</sup>   | A    |
|                                | Drain current (continuous) at T <sub>C</sub> = 100 °C                                                           | 20.8                                                      | 20.8 <sup>(1)</sup> | A    |
| I <sub>DM</sub> <sup>(2)</sup> | Drain current (pulsed)                                                                                          | 132                                                       | 132                 | A    |
| P <sub>TOT</sub>               | Total power dissipation at T <sub>C</sub> = 25 °C                                                               | 190                                                       | 40                  | W    |
| dv/dt <sup>(3)</sup>           | Peak diode recovery voltage slope                                                                               | 15                                                        |                     | V/ns |
| V <sub>ISO</sub>               | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C) |                                                           | 2500                | V    |
| T <sub>J</sub>                 | Operating junction temperature range                                                                            | -55 to 150                                                |                     | °C   |
| T <sub>stg</sub>               | Storage temperature range                                                                                       |                                                           |                     |      |

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. I<sub>SD</sub> ≤ 33 A, di/dt ≤ 400 A/μs, V<sub>DD</sub> = 400 V, V<sub>DS(peak)</sub> < V<sub>(BR)DSS</sub>.

**Table 2. Thermal data**

| Symbol                              | Parameter                           | Value              |                    |        |        |          | Unit |
|-------------------------------------|-------------------------------------|--------------------|--------------------|--------|--------|----------|------|
|                                     |                                     | D <sup>2</sup> PAK | I <sup>2</sup> PAK | TO-220 | TO-247 | TO-220FP |      |
| R <sub>thj-case</sub>               | Thermal resistance junction-case    | 0.66               |                    |        |        | 3.1      | °C/W |
| R <sub>thj-amb</sub>                | Thermal resistance junction-ambient |                    | 62.5               |        | 50     | 62.5     | °C/W |
| R <sub>thj-pcb</sub> <sup>(1)</sup> | Thermal resistance junction-pcb     | 30                 |                    |        |        |          | °C/W |

1. When mounted on an 1 inch<sup>2</sup> FR-4, 2 Oz copper board.

**Table 3. Avalanche characteristics**

| Symbol          | Parameter                                                                                                                  | Value | Unit |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|-------|------|
| I <sub>AR</sub> | Avalanche current, repetitive or non-repetitive (pulse width limited by T <sub>Jmax</sub> )                                | 11    | A    |
| E <sub>AS</sub> | Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 950   | mJ   |

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                          | Test conditions                                                                                         | Min. | Typ. | Max. | Unit          |
|---------------|------------------------------------|---------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage     | $I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$                                                             | 650  |      |      | V             |
| $I_{DSS}$     | Zero gate voltage drain current    | $V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$                                                         |      |      | 1    | $\mu\text{A}$ |
|               |                                    | $V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ ,<br>$T_C = 125\text{ }^{\circ}\text{C}$ <sup>(1)</sup> |      |      | 100  | $\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current          | $V_{GS} = \pm 25\text{ V}$ , $V_{DS} = 0\text{ V}$                                                      |      |      | 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 | $V_{GS} = 10\text{ V}$ , $I_D = 16.5\text{ A}$                                                          |      | 70   | 79   | m $\Omega$    |

1. Defined by design, not subject to production test.

**Table 5. Dynamic**

| Symbol            | Parameter                             | Test conditions                                                         | Min. | Typ. | Max. | Unit     |
|-------------------|---------------------------------------|-------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$         | Input capacitance                     | $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0\text{ V}$ | -    | 4650 | -    | pF       |
| $C_{oss}$         | Output capacitance                    |                                                                         |      | 110  |      |          |
| $C_{rss}$         | Reverse transfer capacitance          |                                                                         |      | 3.2  |      |          |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related   | $V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0\text{ V}$             | -    | 100  | -    | pF       |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related |                                                                         |      | 285  |      |          |
| $R_g$             | Gate input resistance                 | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$                                 | -    | 1.1  | -    | $\Omega$ |
| $Q_g$             | Total gate charge                     | $V_{DD} = 520\text{ V}$ , $I_D = 33\text{ A}$ ,                         | -    | 98   | -    | nC       |
| $Q_{gs}$          | Gate-source charge                    | $V_{GS} = 0\text{ to }10\text{ V}$                                      |      | 28   |      |          |
| $Q_{gd}$          | Gate-drain charge                     | (see Figure 20. Test circuit for gate charge behavior)                  |      | 39   |      |          |

1.  $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

2.  $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**Table 6. Switching times**

| Symbol       | Parameter          | Test conditions                                                                                                                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(v)}$   | Voltage delay time | $V_{DD} = 400\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 21. Test circuit for inductive load switching and diode recovery times and Figure 24. Switching time waveform) | -    | 52   | -    | ns   |
| $t_{r(v)}$   | Voltage rise time  |                                                                                                                                                                                                                                     |      | 8.4  |      |      |
| $t_{f(i)}$   | Current fall time  |                                                                                                                                                                                                                                     |      | 8.7  |      |      |
| $t_{c(off)}$ | Crossing time      |                                                                                                                                                                                                                                     |      | 14   |      |      |

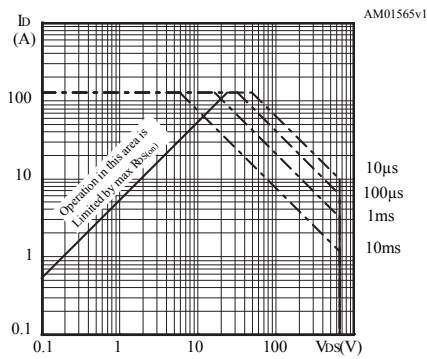
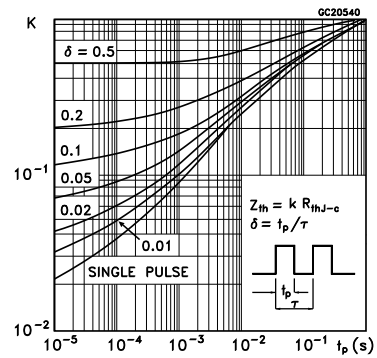
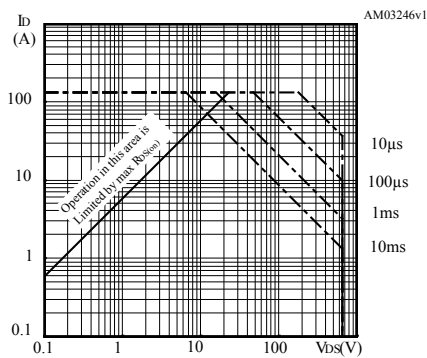
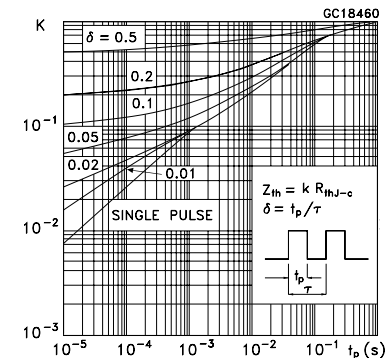
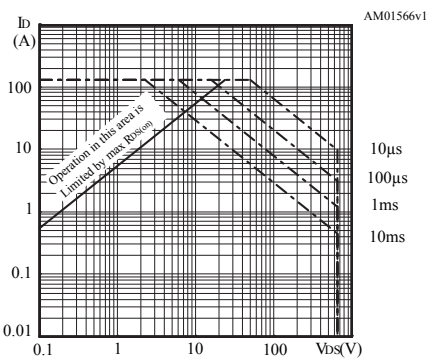
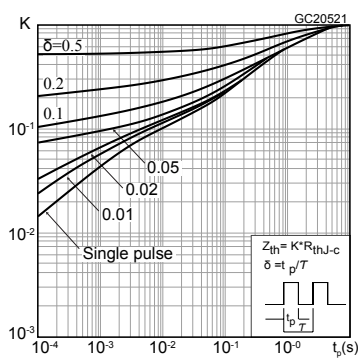
**Table 7. Source-drain diode**

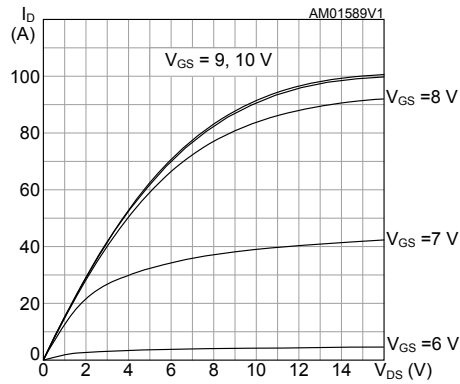
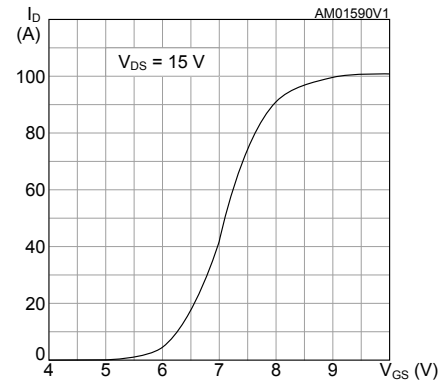
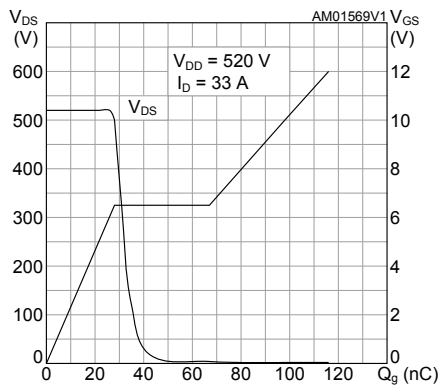
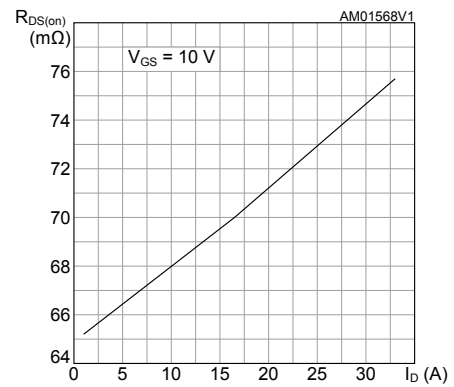
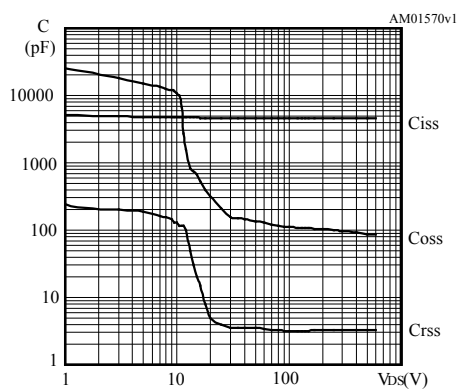
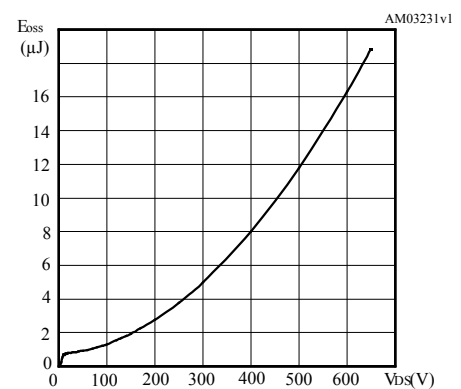
| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                   | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                   | -    |      | 33   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                   |      |      | 132  |               |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 33\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                                                                                                    | -    |      | 1.5  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 33\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$<br>(see Figure 21. Test circuit for inductive load switching and diode recovery times)                                     | -    | 400  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                   |      | 7    |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                   |      | 35   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 33\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see Figure 21. Test circuit for inductive load switching and diode recovery times) | -    | 532  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                   |      | 10   |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                   |      | 38   |      | A             |

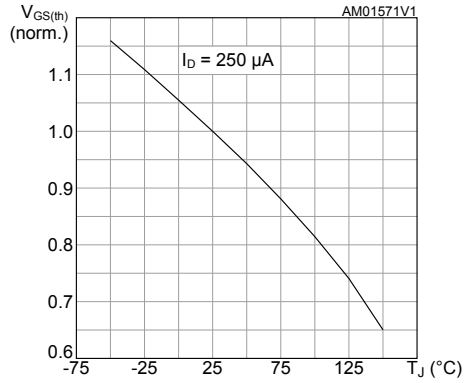
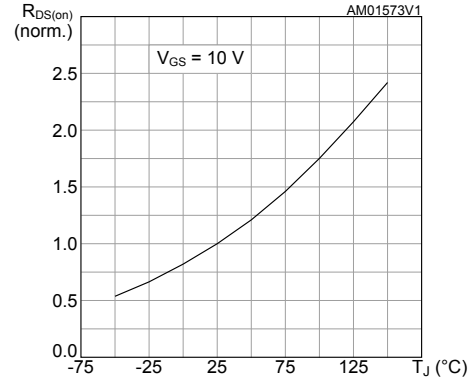
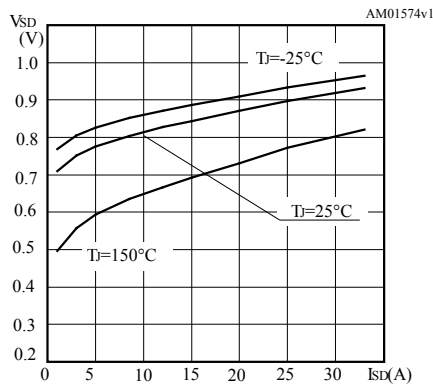
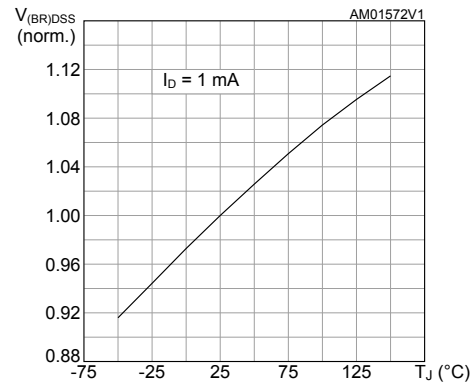
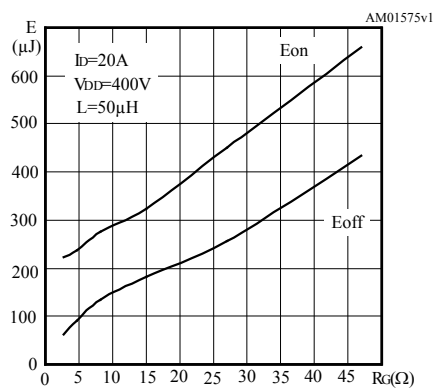
1. Pulse width limited by safe operating area.

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

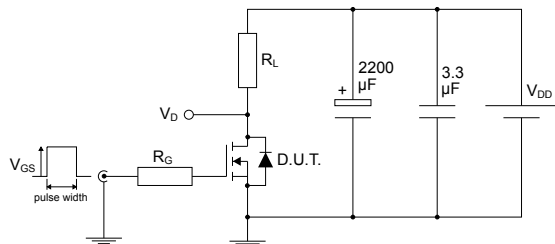
**Figure 1. Safe operating area for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220**

**Figure 2. Thermal impedance for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220**

**Figure 3. Safe operating area for TO-247**

**Figure 4. Thermal impedance for TO-247**

**Figure 5. Safe operating area for TO-220FP**

**Figure 6. Thermal impedance for TO-220FP**


**Figure 7. Output characteristics**

**Figure 8. Transfer characteristics**

**Figure 9. Gate charge vs gate-source voltage**

**Figure 10. Static drain-source on-resistance**

**Figure 11. Capacitance variations**

**Figure 12. Output capacitance stored energy**


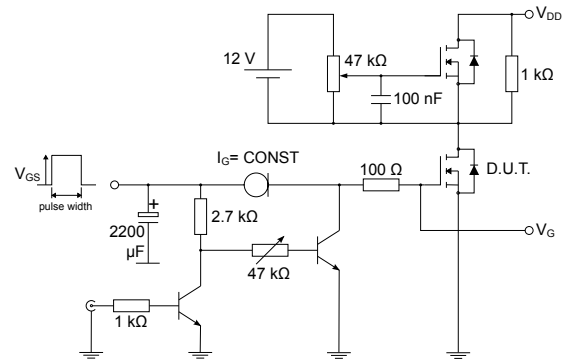
**Figure 13. Normalized gate threshold voltage vs temperature**

**Figure 14. Normalized on-resistance vs temperature**

**Figure 15. Source-drain diode forward characteristics**

**Figure 16. Normalized  $V_{(BR)DSS}$  vs temperature**

**Figure 17. Switching energy vs gate resistance**


Note:  $E_{on}$  including reverse recovery of a SiC diode.

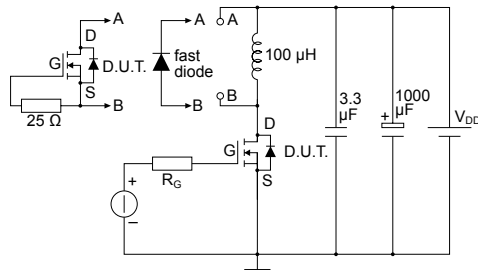
### 3 Test circuits

**Figure 19. Test circuit for resistive load switching times**


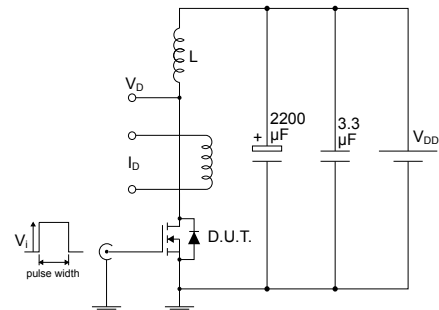
AM01468v1

**Figure 20. Test circuit for gate charge behavior**


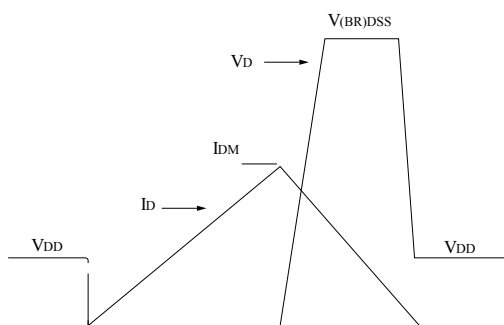
AM01469v1

**Figure 21. Test circuit for inductive load switching and diode recovery times**


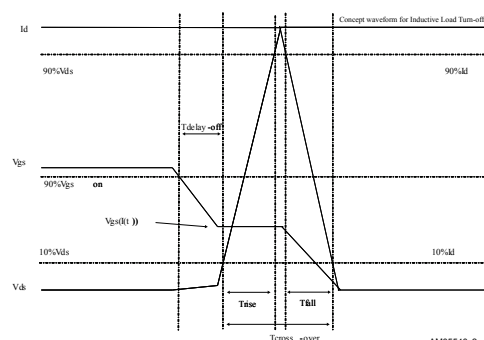
AM01470v1

**Figure 22. Unclamped inductive load test circuit**


AM01471v1

**Figure 23. Unclamped inductive waveform**


AM01472v1

**Figure 24. Switching time waveform**


AM05540v2



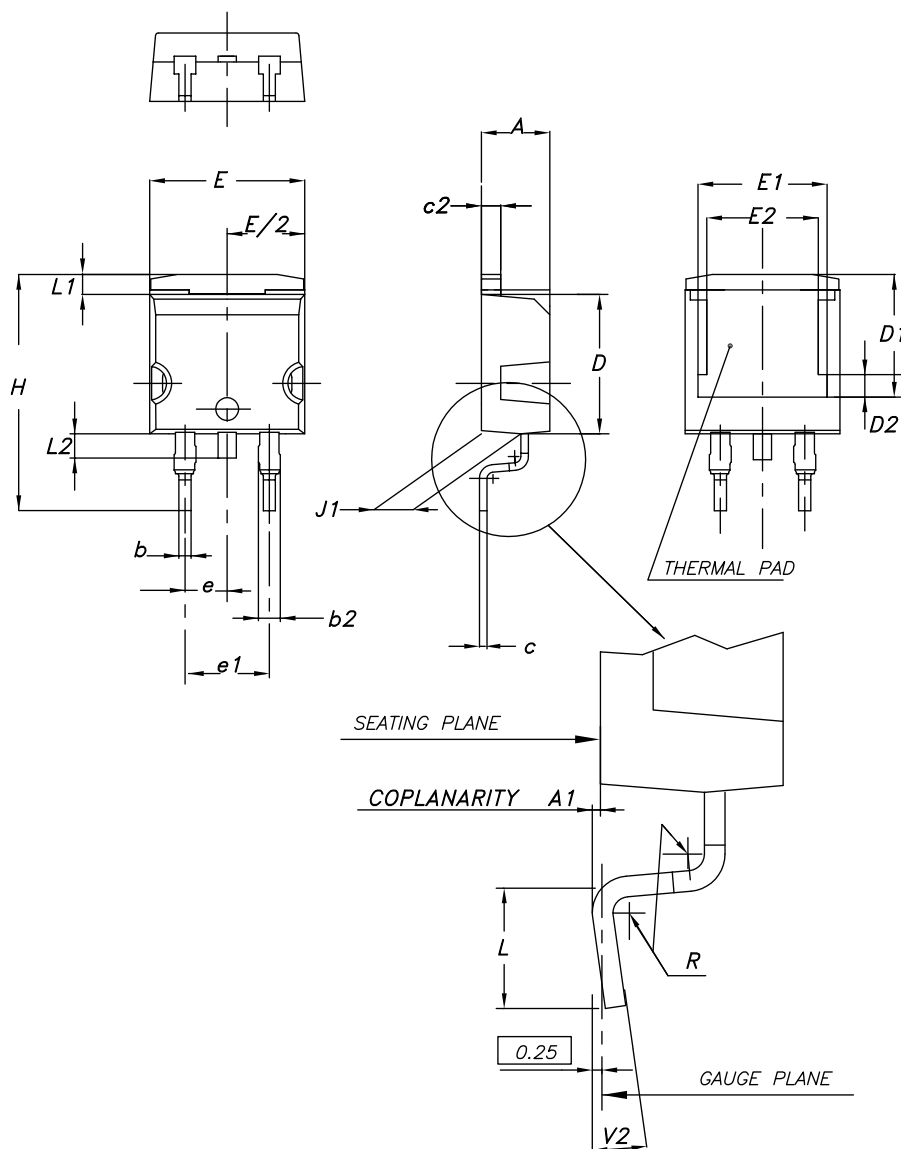
## **4 Package information**

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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](http://www.st.com). ECOPACK is an ST trademark.

## 4.1 D<sup>2</sup>PAK (TO-263) type A2 package information

Figure 25. D<sup>2</sup>PAK (TO-263) type A2 package outline

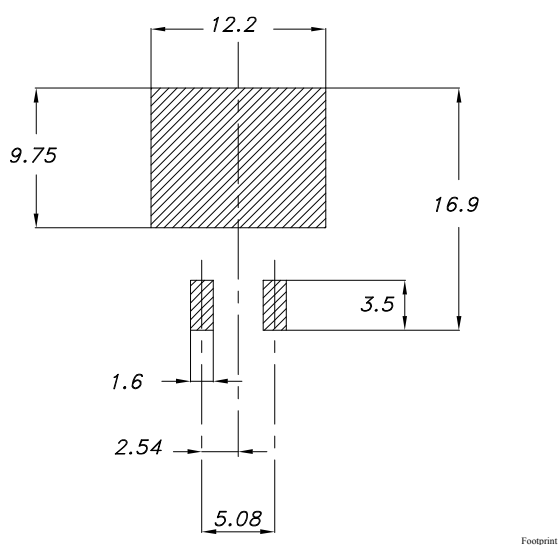


0079457\_A2\_26

**Table 8. D<sup>2</sup>PAK (TO-263) type A2 package mechanical data**

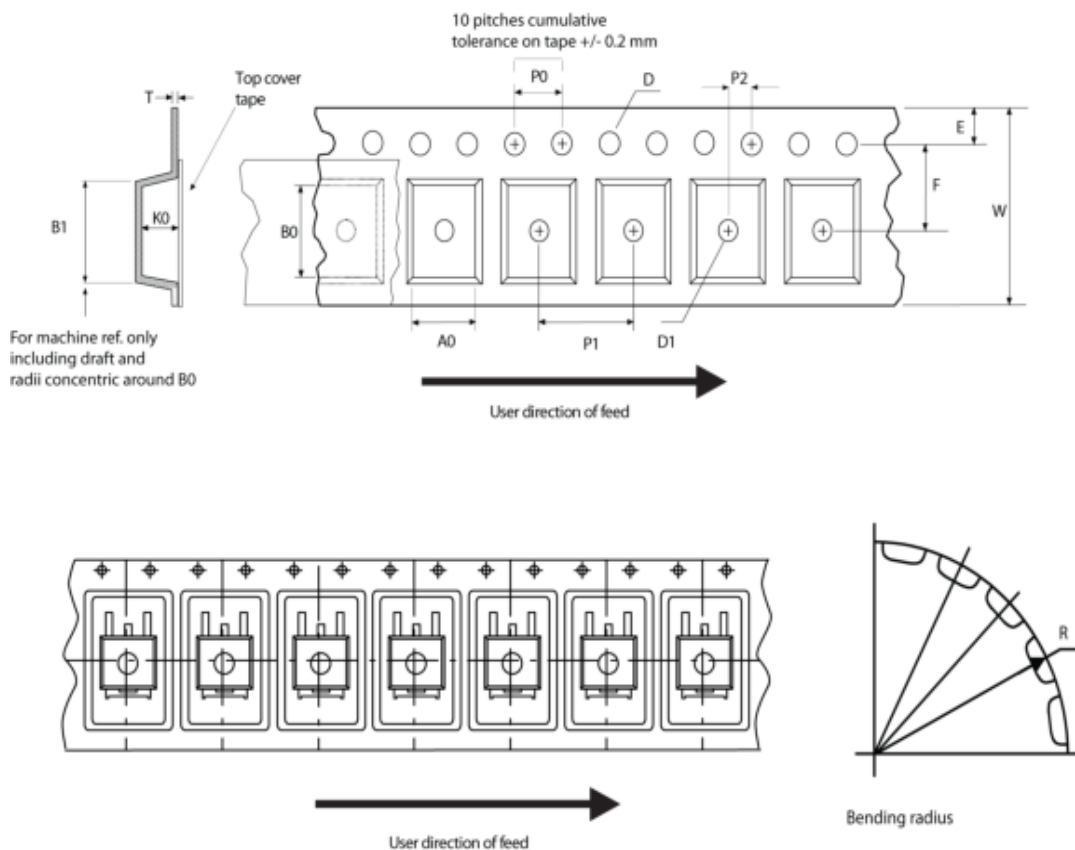
| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 4.40  |      | 4.60  |
| A1   | 0.03  |      | 0.23  |
| b    | 0.70  |      | 0.93  |
| b2   | 1.14  |      | 1.70  |
| c    | 0.45  |      | 0.60  |
| c2   | 1.23  |      | 1.36  |
| D    | 8.95  |      | 9.35  |
| D1   | 7.50  | 7.75 | 8.00  |
| D2   | 1.10  | 1.30 | 1.50  |
| E    | 10.00 |      | 10.40 |
| E1   | 8.70  | 8.90 | 9.10  |
| E2   | 7.30  | 7.50 | 7.70  |
| 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 26. D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)**

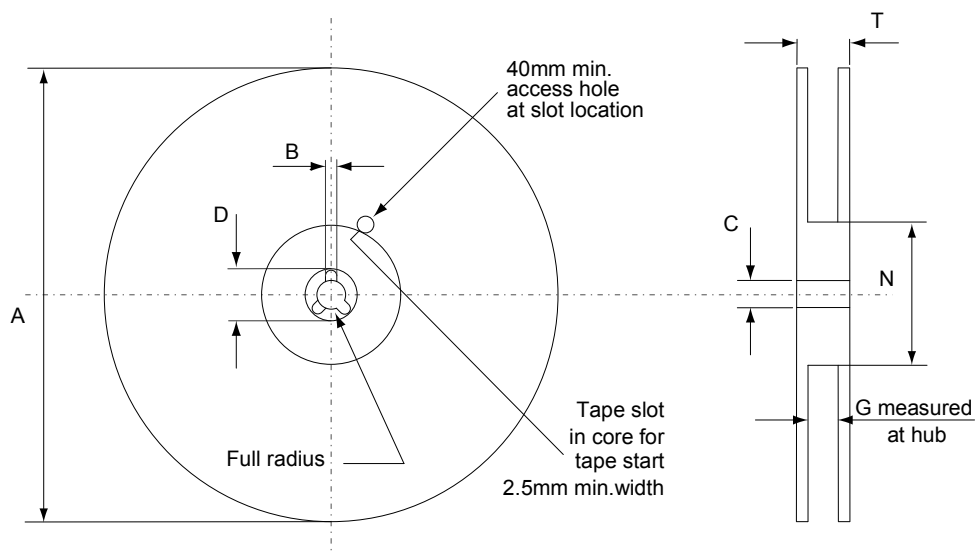


## 4.2 D<sup>2</sup>PAK packing information

**Figure 27. D<sup>2</sup>PAK tape outline**



AM08852v1

**Figure 28. D<sup>2</sup>PAK reel outline**


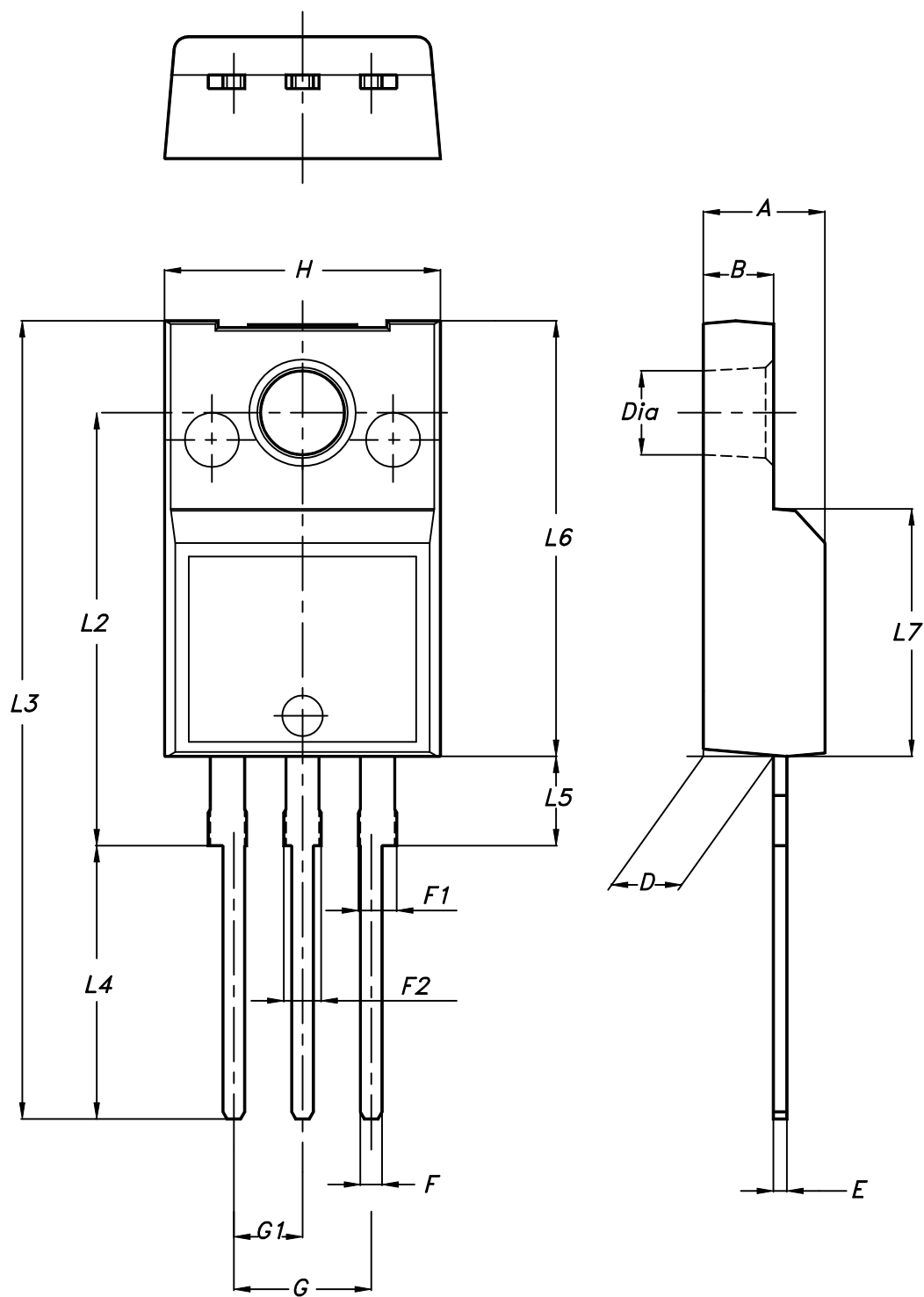
AM06038v1

**Table 9. D<sup>2</sup>PAK 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 quantity |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk quantity |      | 1000 |
| R    | 50   |      |               |      |      |
| T    | 0.25 | 0.35 |               |      |      |
| W    | 23.7 | 24.3 |               |      |      |

### 4.3 TO-220FP package information

Figure 29. TO-220FP package outline



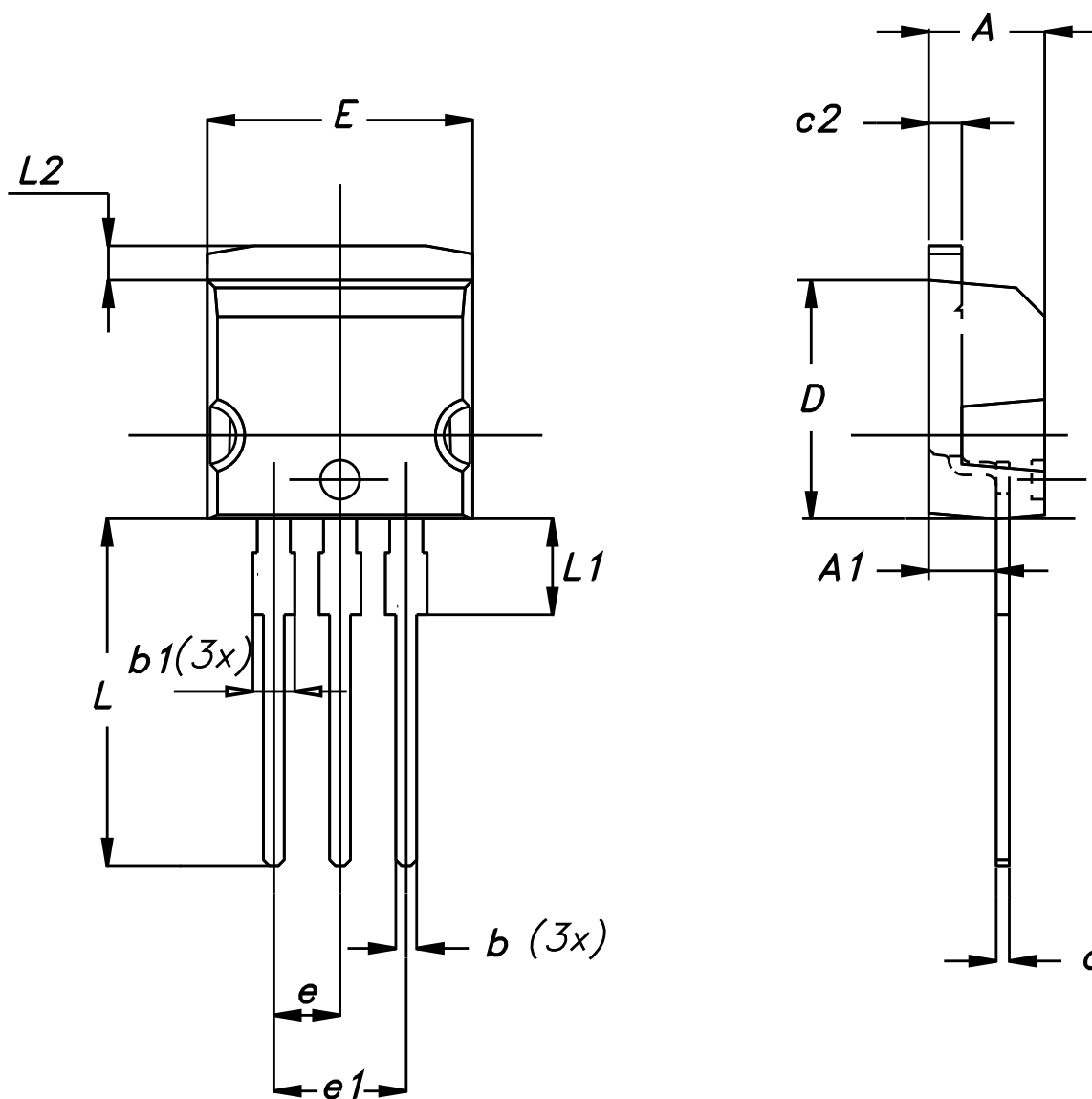
7012510\_Rev\_12\_B

**Table 10. TO-220FP package mechanical data**

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.70 |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |

#### 4.4 I<sup>2</sup>PAK package information

Figure 30. I<sup>2</sup>PAK package outline



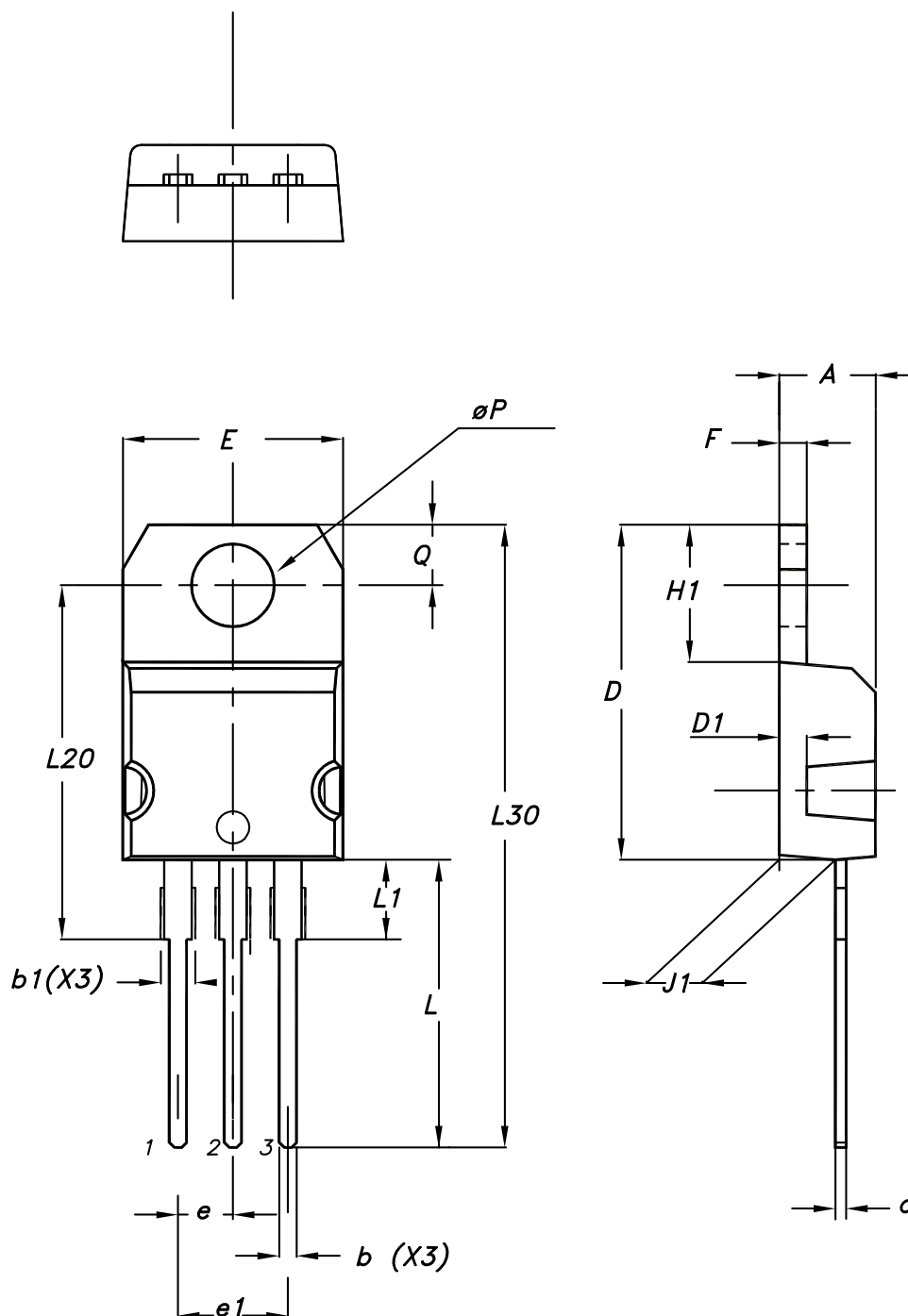
0004982\_Rev\_H

**Table 11. I<sup>2</sup>PAK package mechanical data**

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 | -    | 4.60  |
| A1   | 2.40 | -    | 2.72  |
| b    | 0.61 | -    | 0.88  |
| b1   | 1.14 | -    | 1.70  |
| c    | 0.49 | -    | 0.70  |
| c2   | 1.23 | -    | 1.32  |
| D    | 8.95 | -    | 9.35  |
| e    | 2.40 | -    | 2.70  |
| e1   | 4.95 | -    | 5.15  |
| E    | 10   | -    | 10.40 |
| L    | 13   | -    | 14    |
| L1   | 3.50 | -    | 3.93  |
| L2   | 1.27 | -    | 1.40  |

## 4.5 TO-220 type A package information

Figure 31. TO-220 type A package outline



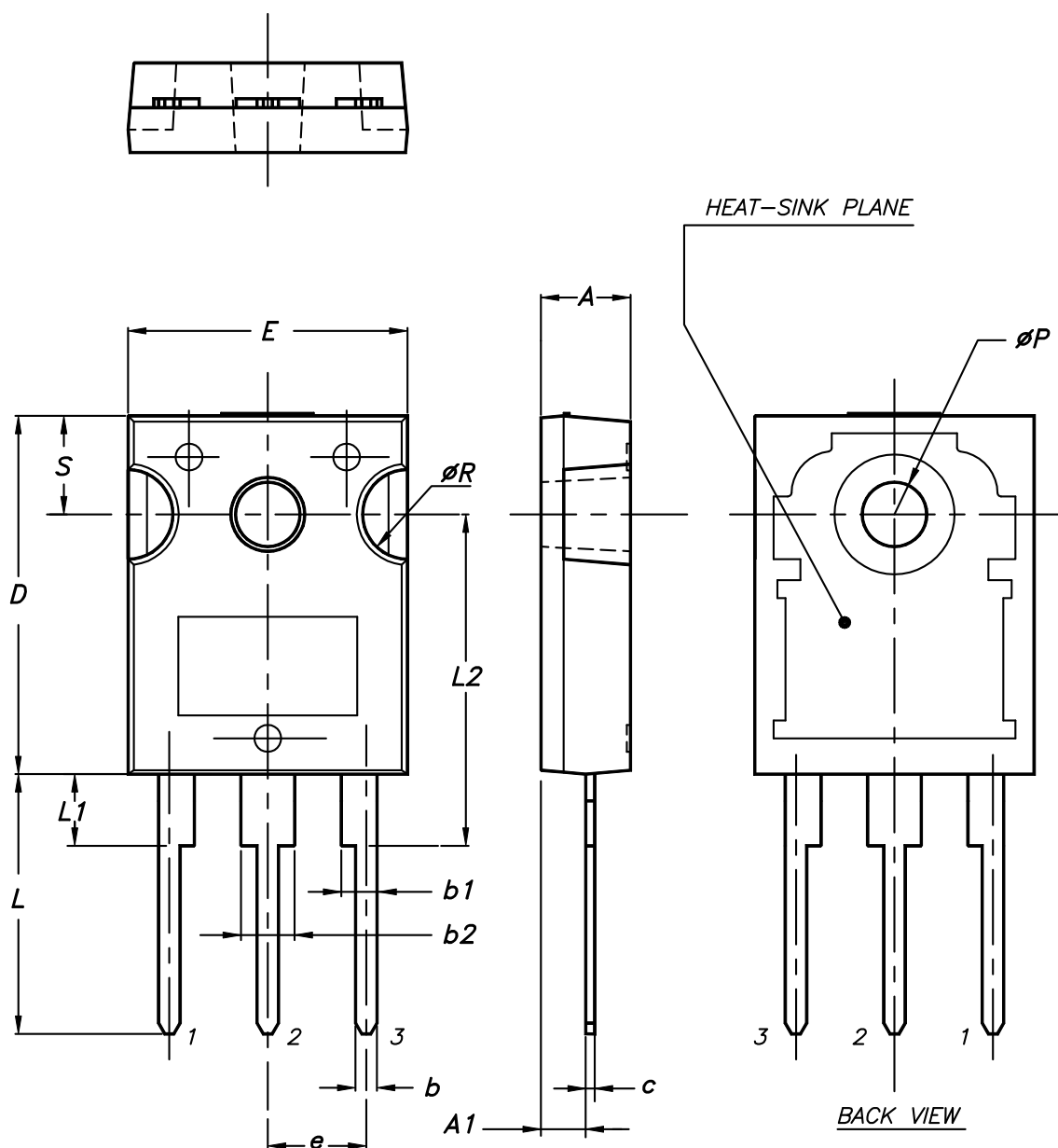
0015988\_typeA\_Rev\_22

**Table 12. 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  |

## 4.6 TO-247 package information

Figure 32. TO-247 package outline



0075325\_9

**Table 13. 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  |



## 5 Ordering information

Table 14. Order codes

| Order code | Marking | Package            | Packing       |
|------------|---------|--------------------|---------------|
| STB42N65M5 | 42N65M5 | D <sup>2</sup> PAK | Tape and reel |
| STF42N65M5 |         | TO-220FP           | Tube          |
| STI42N65M5 |         | I <sup>2</sup> PAK |               |
| STP42N65M5 |         | TO-220             |               |
| STW42N65M5 |         | TO-247             |               |

## Revision history

**Table 15. Document revision history**

| Date        | Version | Changes                                                                                                                            |
|-------------|---------|------------------------------------------------------------------------------------------------------------------------------------|
| 16-Jan-2009 | 1       | First release.                                                                                                                     |
| 15-May-2009 | 2       | Updated <i>figures 9, 10, 11</i> and <i>17</i>                                                                                     |
| 12-Jun-2009 | 3       | <i>Figure 15</i> has been updated                                                                                                  |
| 02-May-2019 | 4       | Modified features and description on cover page.<br>Updated <a href="#">Section 4 Package information</a> .<br>Minor text changes. |

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