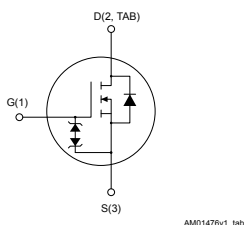
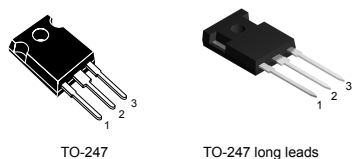


## N-channel 600 V, 36 mΩ typ., 62 A, MDmesh DM6 Power MOSFETs in TO-247 and TO-247 long leads packages

### Features



| Order code   | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|--------------|----------|-------------------|-------|
| STW70N60DM6  | 600 V    | 42 mΩ             | 62 A  |
| STWA70N60DM6 |          |                   |       |

- 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

[STW70N60DM6](#)

[STWA70N60DM6](#)

#### Product summary

##### STW70N60DM6

|            |             |
|------------|-------------|
| Order code | STW70N60DM6 |
| Marking    | 70N60DM6    |
| Package    | TO-247      |
| Packing    | Tube        |

##### STWA70N60DM6

|            |                   |
|------------|-------------------|
| Order code | STWA70N60DM6      |
| Marking    | 70N60DM6          |
| Package    | TO-247 long leads |
| Packing    | Tube              |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol        | Parameter                                                         | Value      | Unit               |
|---------------|-------------------------------------------------------------------|------------|--------------------|
| $V_{GS}$      | Gate-source voltage                                               | $\pm 25$   | V                  |
| $I_D$         | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$  | 62         | A                  |
| $I_D$         | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 39         | A                  |
| $I_D^{(1)}$   | Drain current (pulsed)                                            | 220        | A                  |
| $P_{TOT}$     | Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$     | 390        | W                  |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope                                 | 100        | V/ns               |
| $di/dt^{(2)}$ | Peak diode recovery current slope                                 | 1000       | A/ $\mu$ s         |
| $dv/dt^{(3)}$ | MOSFET $dv/dt$ ruggedness                                         | 100        | V/ns               |
| $T_{STG}$     | Storage temperature range                                         | -55 to 150 | $^{\circ}\text{C}$ |
| $T_J$         | Operating junction temperature range                              |            | $^{\circ}\text{C}$ |

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 25\text{ A}$ ,  $V_{DS(peak)} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$
3.  $V_{DS} \leq 480\text{ V}$

**Table 2. Thermal data**

| Symbol         | Parameter                           | Value | Unit                 |
|----------------|-------------------------------------|-------|----------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 0.32  | $^{\circ}\text{C/W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 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 $T_{jmax}$ )                                   | 7     | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 1850  | mJ   |

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                         | Test conditions                                                                                | Min. | Typ. | Max.    | Unit          |
|---------------|-----------------------------------|------------------------------------------------------------------------------------------------|------|------|---------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$                                                    | 600  |      |         | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$                                                |      |      | 5       | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ ,<br>$T_J = 125\text{ }^{\circ}\text{C}^{(1)}$ |      |      | 100     |               |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$                                             |      |      | $\pm 5$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | 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 | $V_{GS} = 10\text{ V}$ , $I_D = 31\text{ A}$                                                   |      | 36   | 42      | m $\Omega$    |

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

**Table 5. Dynamic characteristics**

| Symbol                    | Parameter                     | Test conditions                                                                                                                               | Min. | Typ. | Max. | Unit     |
|---------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$                 | Input capacitance             | $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$                                                                          | -    | 4360 | -    | pF       |
| $C_{oss}$                 | Output capacitance            |                                                                                                                                               | -    | 235  | -    |          |
| $C_{rss}$                 | Reverse transfer capacitance  |                                                                                                                                               | -    | 13   | -    |          |
| $C_{oss\text{ eq}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0$ to $480\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                        | -    | 286  | -    |          |
| $R_G$                     | Intrinsic gate resistance     | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$                                                                                                       | -    | 1.5  | -    | $\Omega$ |
| $Q_g$                     | Total gate charge             | $V_{DD} = 480\text{ V}$ , $I_D = 62\text{ A}$ ,<br>$V_{GS} = 0$ to $10\text{ V}$ (see<br>Figure 14. Test circuit for gate<br>charge behavior) | -    | 99   | -    | nC       |
| $Q_{gs}$                  | Gate-source charge            |                                                                                                                                               | -    | 28   | -    |          |
| $Q_{gd}$                  | Gate-drain charge             |                                                                                                                                               | -    | 44   | -    |          |

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  | $V_{DD} = 300\text{ V}$ , $I_D = 31\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 13. Test circuit for<br>resistive load switching times and<br>Figure 18. Switching time<br>waveform) | -    | 28   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                                                                                                           | -    | 49   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                                                                                                           | -    | 96   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                                                                                                           | -    | 12   | -    | ns   |

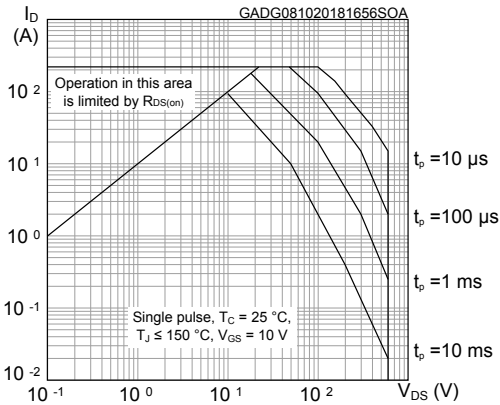
**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                    | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                    | -    |      | 62   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                    | -    |      | 220  | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = 62\text{ A}$                                                                                                                                                                     | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 62\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$<br>(see Figure 15. Test circuit for inductive load switching and diode recovery times)                                     | -    | 138  | -    | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                    | -    | 0.69 | -    | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      | $I_{SD} = 62\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$<br>(see Figure 15. Test circuit for inductive load switching and diode recovery times) | -    | 10   | -    | A             |
| $t_{rr}$        | Reverse recovery time         |                                                                                                                                                                                                                    | -    | 340  | -    | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                    | -    | 4.6  | -    | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                    | -    | 27   | -    | A             |

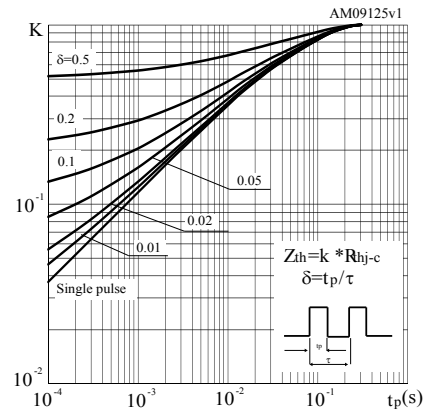
1. Pulse width is limited by safe operating area
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

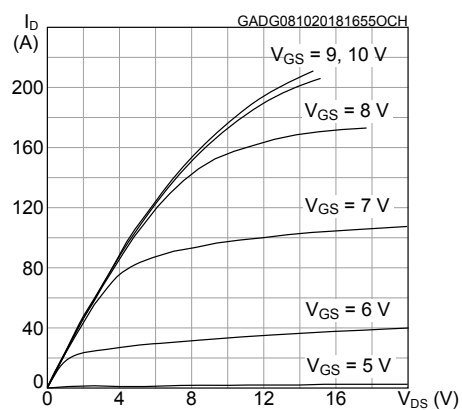
**Figure 1. Safe operating area**



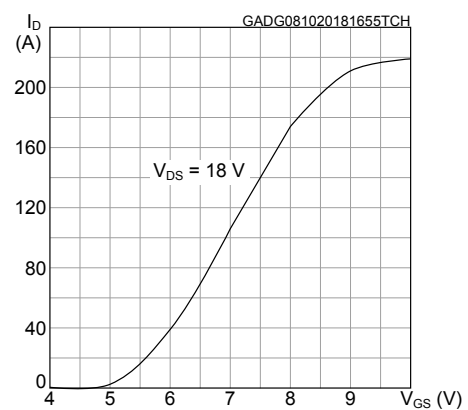
**Figure 2. Thermal impedance**



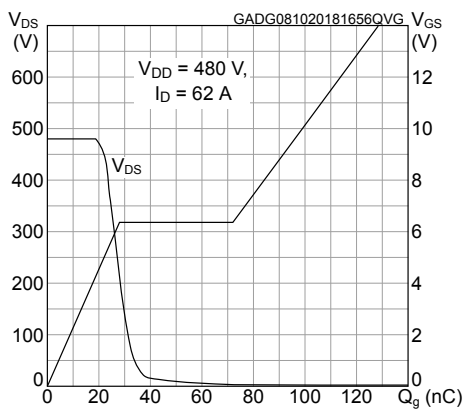
**Figure 3. Output characteristics**



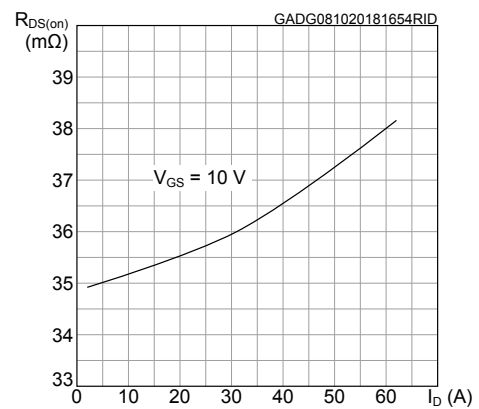
**Figure 4. Transfer characteristics**

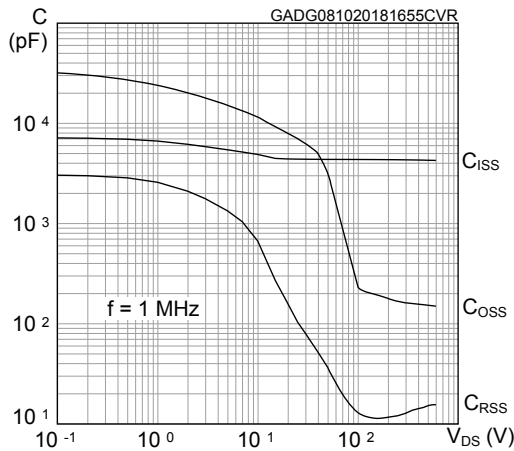
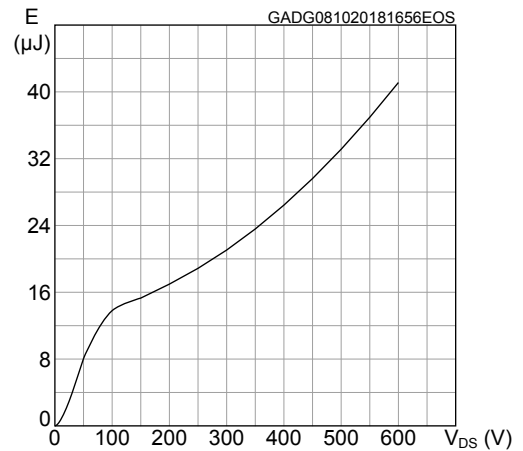
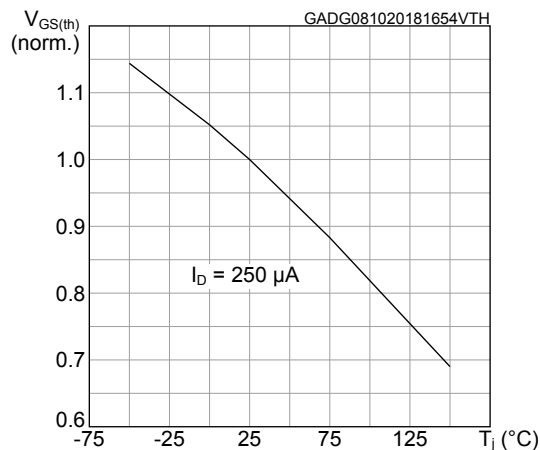
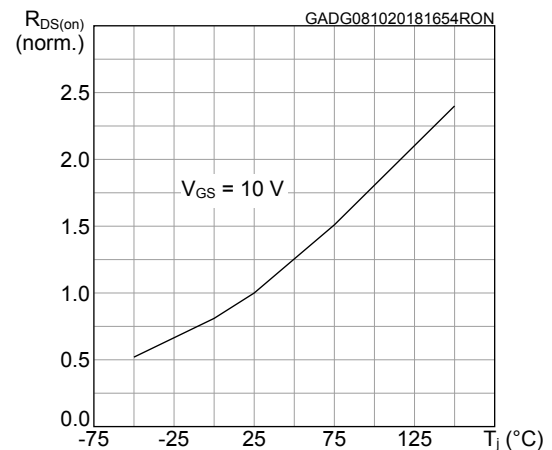
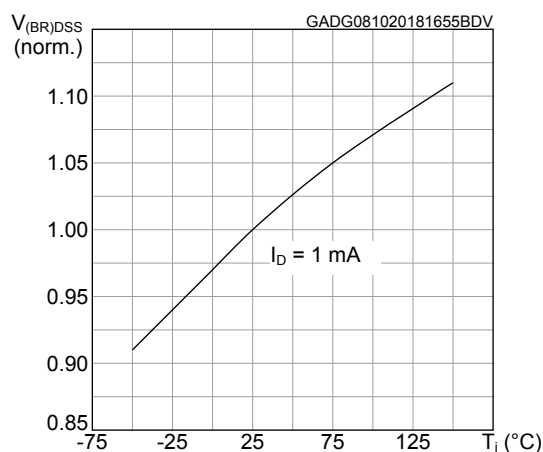
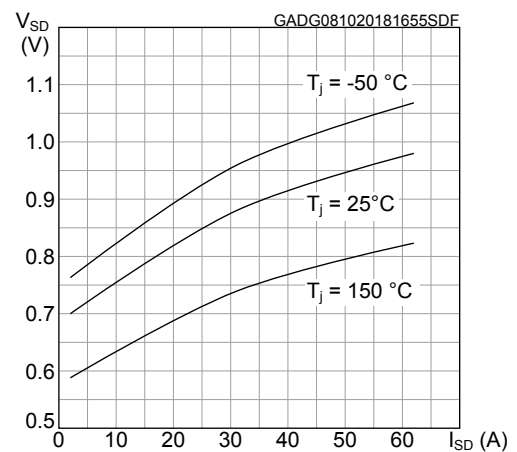


**Figure 5. Gate charge vs gate-source voltage**

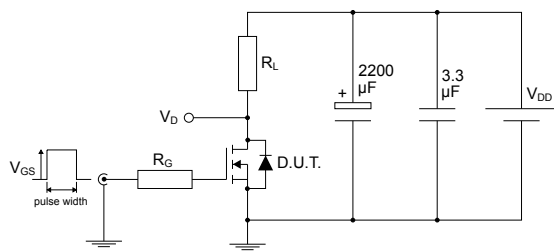


**Figure 6. Static drain-source on-resistance**

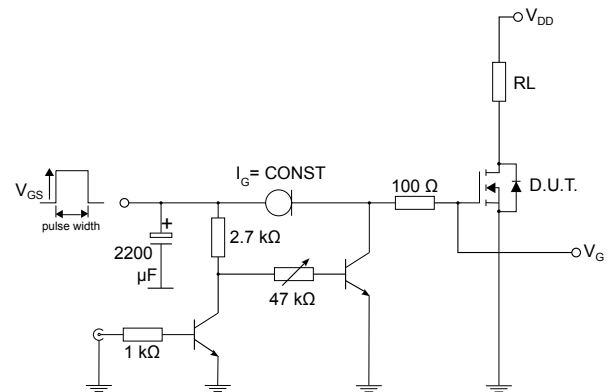


**Figure 7. Capacitance variations**

**Figure 8.  $C_{OSS}$  stored energy vs  $V_{DS}$** 

**Figure 9. Normalized gate threshold voltage vs temperature**

**Figure 10. Normalized on-resistance vs temperature**

**Figure 11. Normalized  $V_{(BR)DSS}$  vs temperature**

**Figure 12. Source-drain diode forward characteristics**


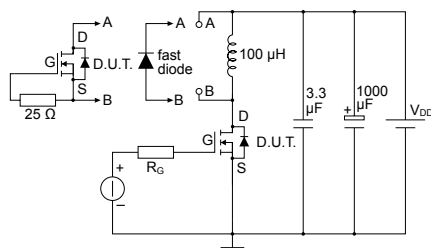
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


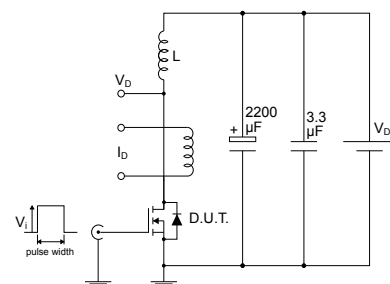
AM01468v1

**Figure 14. Test circuit for gate charge behavior**


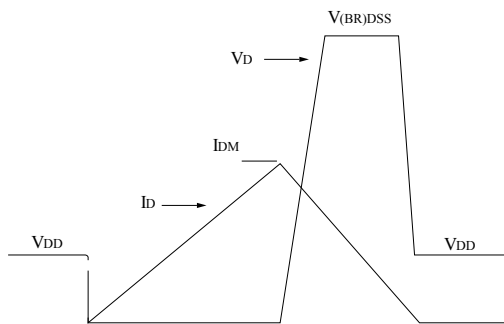
AM01469v10

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


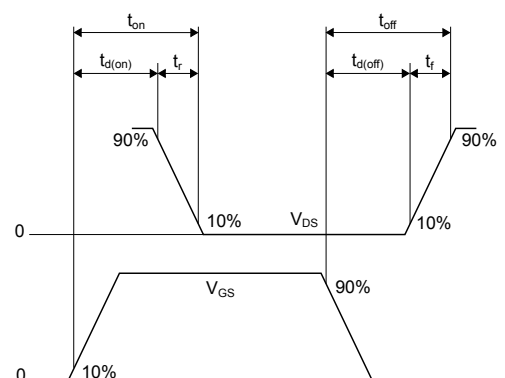
AM01470v1

**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


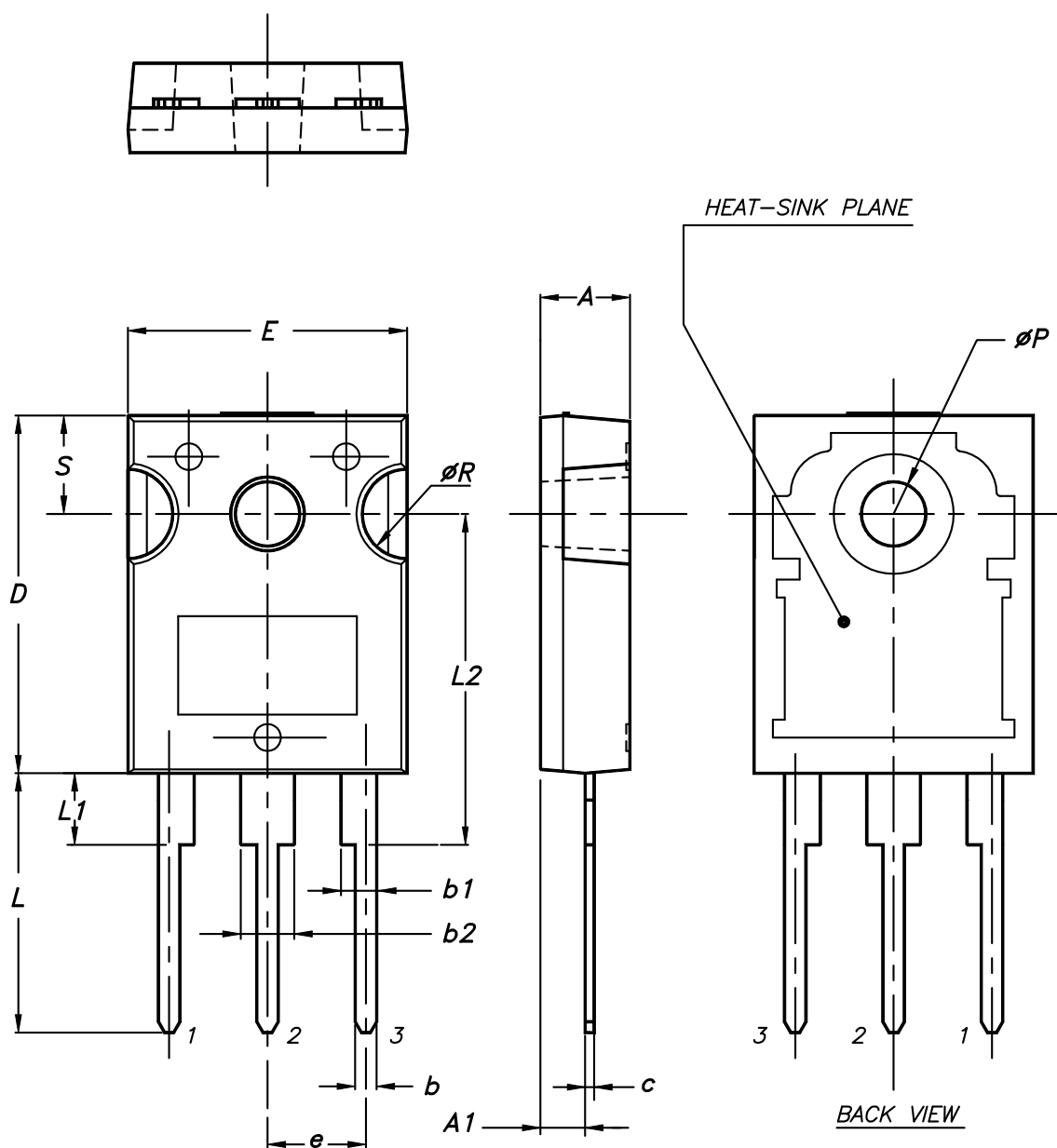
AM01473v1

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

### 4.1 TO-247 package information

Figure 19. TO-247 package outline



0075325\_9

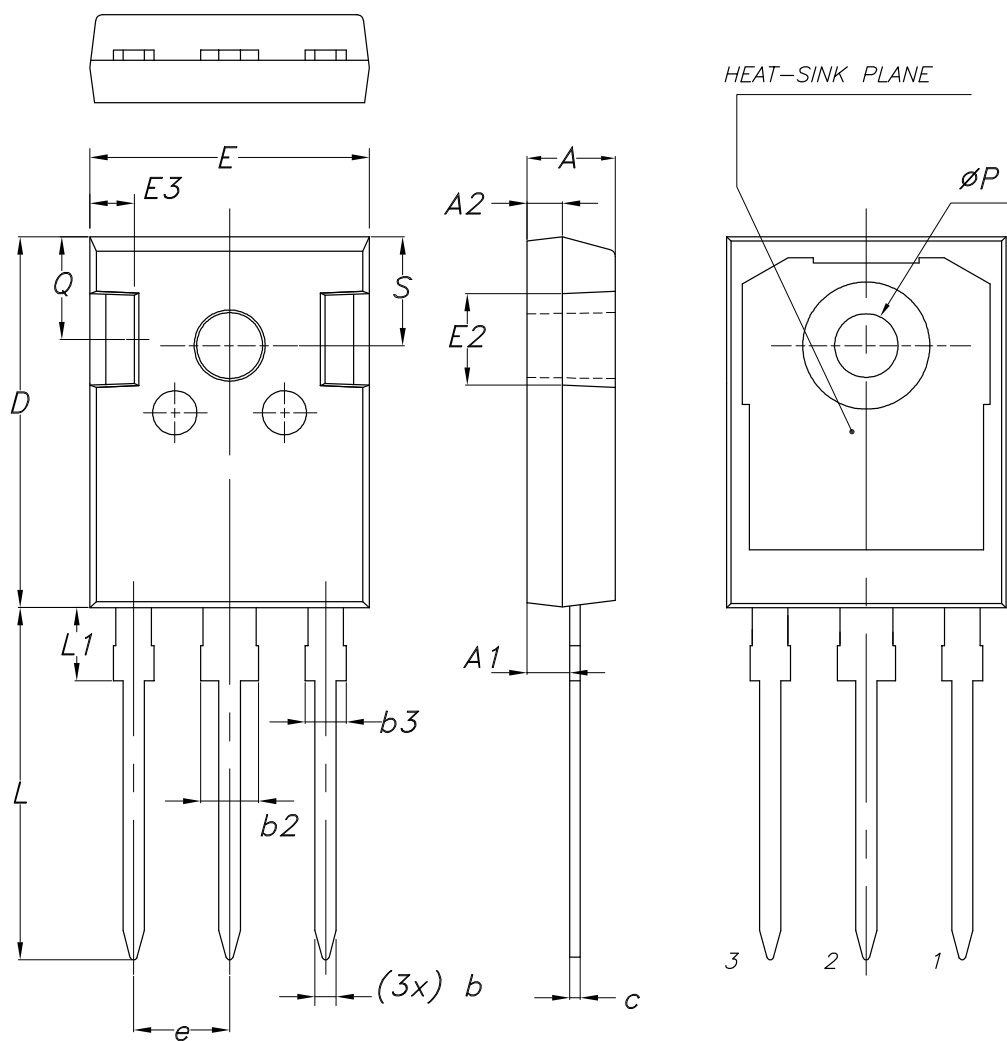


**Table 8. TO-247 package mechanical data**

| 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  |

## 4.2 TO-247 long leads package information

Figure 20. TO-247 long leads package outline



8463846\_2\_F

**Table 9. TO-247 long leads package mechanical data**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.90  | 5.00  | 5.10  |
| A1   | 2.31  | 2.41  | 2.51  |
| A2   | 1.90  | 2.00  | 2.10  |
| b    | 1.16  |       | 1.26  |
| b2   |       |       | 3.25  |
| b3   |       |       | 2.25  |
| c    | 0.59  |       | 0.66  |
| D    | 20.90 | 21.00 | 21.10 |
| E    | 15.70 | 15.80 | 15.90 |
| E2   | 4.90  | 5.00  | 5.10  |
| E3   | 2.40  | 2.50  | 2.60  |
| e    | 5.34  | 5.44  | 5.54  |
| L    | 19.80 | 19.92 | 20.10 |
| L1   |       |       | 4.30  |
| P    | 3.50  | 3.60  | 3.70  |
| Q    | 5.60  |       | 6.00  |
| S    | 6.05  | 6.15  | 6.25  |

## Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                        |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02-Nov-2017 | 1        | First release.                                                                                                                                                                                                                                                 |
| 10-Oct-2018 | 2        | Removed maturity status indication from cover page. The document status is production data.<br>Updated Section 1 Electrical ratings and Section 2 Electrical characteristics.<br>Added Section 2.1 Electrical characteristics (curves).<br>Minor text changes. |
| 02-May-2019 | 3        | Updated Table 6. Switching times.<br>Minor text changes.                                                                                                                                                                                                       |
| 01-Jun-2020 | 4        | Updated <a href="#">Table 1. Absolute maximum ratings</a> and <a href="#">Table 7. Source drain diode</a> .                                                                                                                                                    |

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