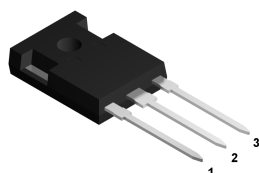
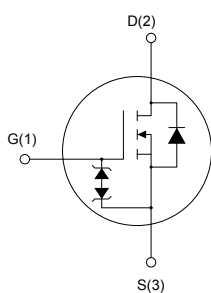


## N-channel 650 V, 0.042 $\Omega$ typ., 60 A MDmesh™ DM2 Power MOSFET in a TO-247 long leads package



TO-247 long leads



AM01476v1\_No\_tab

### Features

| Order code   | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> | P <sub>TOT</sub> |
|--------------|-----------------|--------------------------|----------------|------------------|
| STWA63N65DM2 | 650 V           | 0.050 $\Omega$           | 60 A           | 446 W            |

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

### Applications

- Switching applications

### Description

This high-voltage N-channel Power MOSFET is part of the MDmesh™ DM2 fast recovery diode series. It offers very low recovery charge ( $Q_{rr}$ ) and time ( $t_{rr}$ ) combined with low  $R_{DS(on)}$ , rendering it suitable for the most demanding high-efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

#### Product status link

[STWA63N65DM2](#)

#### Product summary

|            |                   |
|------------|-------------------|
| Order code | STWA63N65DM2      |
| Marking    | 63N65DM2          |
| 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 $T_{case} = 25\text{ }^{\circ}\text{C}$  | 60         | A                  |
|                | Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$ | 38         |                    |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                                 | 240        | A                  |
| $P_{TOT}$      | Total dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$           | 446        | W                  |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                                      | 50         | V/ns               |
| $dv/dt^{(3)}$  | MOSFET $dv/dt$ ruggedness                                              | 50         |                    |
| $T_{stg}$      | Storage temperature range                                              | -55 to 150 | $^{\circ}\text{C}$ |
| $T_j$          | Operating junction temperature range                                   |            |                    |

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 60\text{ A}$ ,  $di/dt=800\text{ A}/\mu\text{s}$ ,  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$
3.  $V_{DS} \leq 520\text{ V}$

**Table 2. Thermal data**

| Symbol         | Parameter                           | Value | Unit                        |
|----------------|-------------------------------------|-------|-----------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 0.28  | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 50    |                             |

**Table 3. Avalanche characteristics**

| Symbol         | Parameter                                       | Value | Unit |
|----------------|-------------------------------------------------|-------|------|
| $I_{AR}$       | Avalanche current, repetitive or non-repetitive | 8     | A    |
| $E_{AS}^{(1)}$ | Single pulse avalanche energy                   | 1100  | mJ   |

1. Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 2 Electrical characteristics

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

**Table 4. Static**

| Symbol                      | Parameter                         | Test conditions                                                                                                          | Min. | Typ.  | Max.    | Unit          |
|-----------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------|------|-------|---------|---------------|
| $V_{(\text{BR})\text{DSS}}$ | Drain-source breakdown voltage    | $V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$                                                              | 650  |       |         | V             |
| $I_{\text{DSS}}$            | Zero gate voltage drain current   | $V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 650\text{ V}$                                                            |      |       | 10      | $\mu\text{A}$ |
|                             |                                   | $V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 650\text{ V}$ ,<br>$T_{\text{case}} = 125\text{ }^{\circ}\text{C}^{(1)}$ |      |       | 100     |               |
| $I_{\text{GSS}}$            | Gate-body leakage current         | $V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 25\text{ V}$                                                         |      |       | $\pm 5$ | $\mu\text{A}$ |
| $V_{\text{GS(th)}}$         | Gate threshold voltage            | $V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$                                                | 3    | 4     | 5       | V             |
| $R_{\text{DS(on)}}$         | Static drain-source on-resistance | $V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 30\text{ A}$                                                             |      | 0.042 | 0.050   | $\Omega$      |

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

**Table 5. Dynamic**

| Symbol                     | Parameter                     | Test conditions                                                                                                                                                  | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{\text{iss}}$           | Input capacitance             | $V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$                                                                               | -    | 5500 | -    | pF       |
| $C_{\text{oss}}$           | Output capacitance            |                                                                                                                                                                  | -    | 210  | -    |          |
| $C_{\text{rss}}$           | Reverse transfer capacitance  |                                                                                                                                                                  | -    | 3    | -    |          |
| $C_{\text{oss eq.}}^{(1)}$ | Equivalent output capacitance | $V_{\text{DS}} = 0\text{ to }520\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$                                                                                        | -    | 456  | -    | pF       |
| $R_{\text{G}}$             | Intrinsic gate resistance     | $f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$                                                                                                                 | -    | 3.3  | -    | $\Omega$ |
| $Q_{\text{g}}$             | Total gate charge             | $V_{\text{DD}} = 520\text{ V}$ , $I_{\text{D}} = 60\text{ A}$ , $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior) | -    | 120  | -    | nC       |
| $Q_{\text{gs}}$            | Gate-source charge            |                                                                                                                                                                  | -    | 27   | -    |          |
| $Q_{\text{gd}}$            | Gate-drain charge             |                                                                                                                                                                  | -    | 58   | -    |          |

1.  $C_{\text{oss eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{\text{oss}}$  when  $V_{\text{DS}}$  increases from 0 to 80%  $V_{\text{DSS}}$ .

**Table 6. Switching times**

| Symbol              | Parameter           | Test conditions                                                                                                                                                                                                                               | Min. | Typ. | Max. | Unit |
|---------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{\text{d(on)}}$  | Turn-on delay time  | $V_{\text{DD}} = 325\text{ V}$ , $I_{\text{D}} = 30\text{ A}$ , $R_{\text{G}} = 4.7\text{ }\Omega$ ,<br>$V_{\text{GS}} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform) | -    | 33   | -    | ns   |
| $t_{\text{r}}$      | Rise time           |                                                                                                                                                                                                                                               | -    | 13.5 | -    |      |
| $t_{\text{d(off)}}$ | Turn-off delay time |                                                                                                                                                                                                                                               | -    | 114  | -    |      |
| $t_{\text{f}}$      | Fall time           |                                                                                                                                                                                                                                               | -    | 11.5 | -    |      |

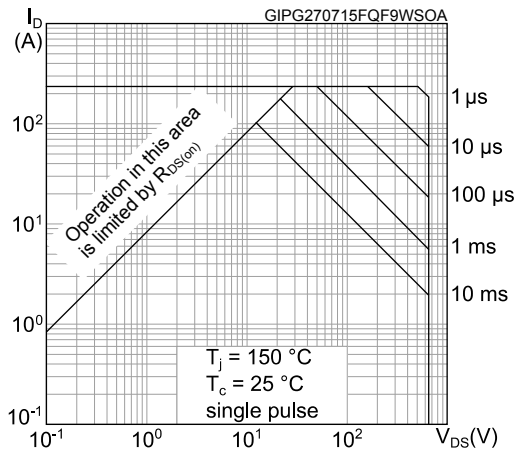
**Table 7. Source-drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                 | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                 | -    |      | 60   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                 | -    |      | 240  | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = 60\text{ A}$                                                                                                                                                                  | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 60\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)                                     | -    | 154  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                 | -    | 0.94 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                 | -    | 12.2 |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 60\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times) | -    | 288  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                 | -    | 3.65 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                 | -    | 25.4 |      | A             |

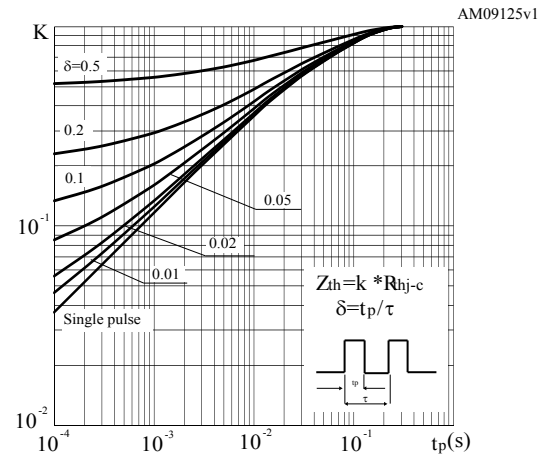
1. Pulse width is limited by safe operating area.
2. Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

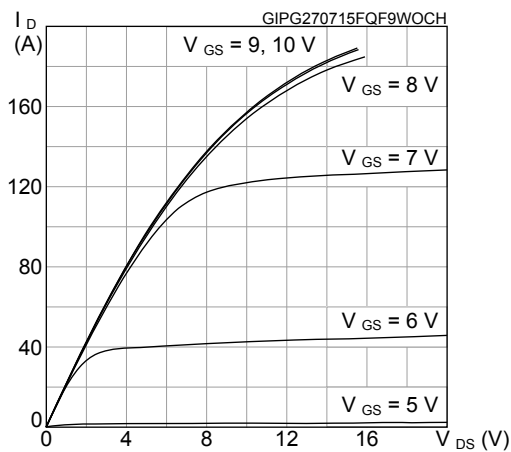
**Figure 1. Safe operating area**



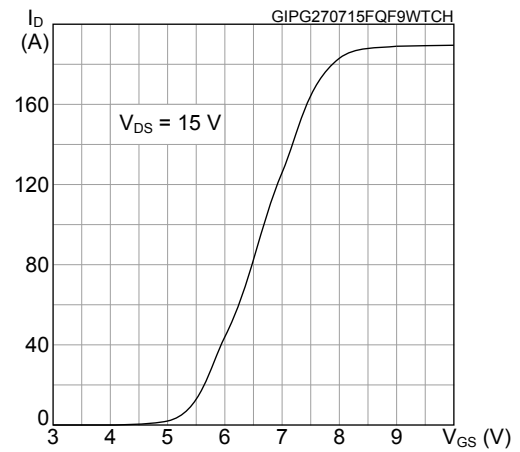
**Figure 2. Thermal impedance**



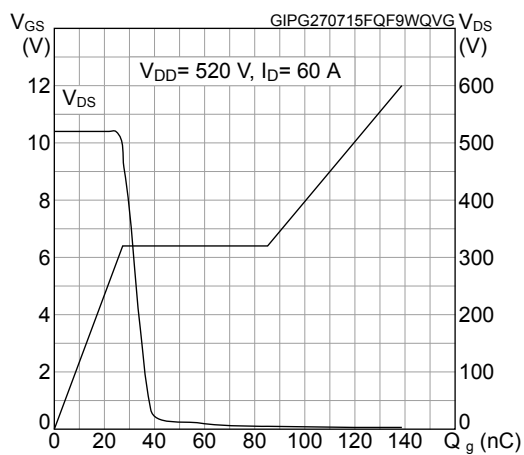
**Figure 3. Output characteristics**



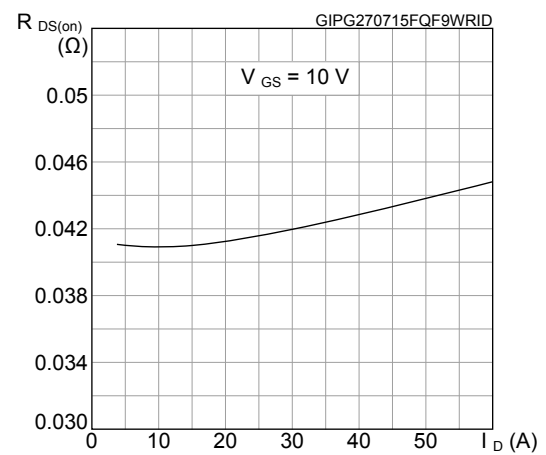
**Figure 4. Transfer characteristics**



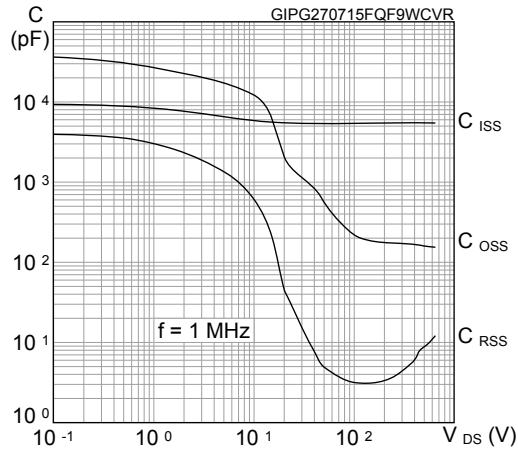
**Figure 5. Gate charge vs gate-source voltage**



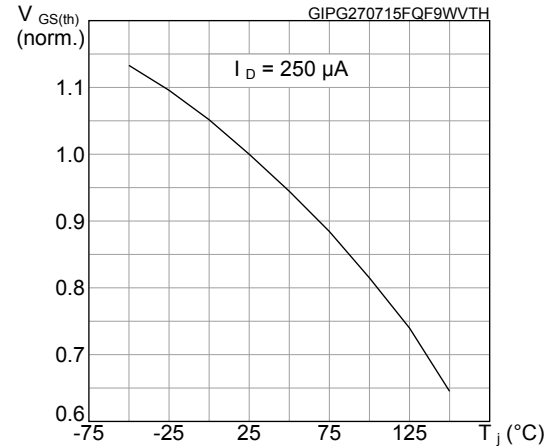
**Figure 6. Static drain-source on-resistance**



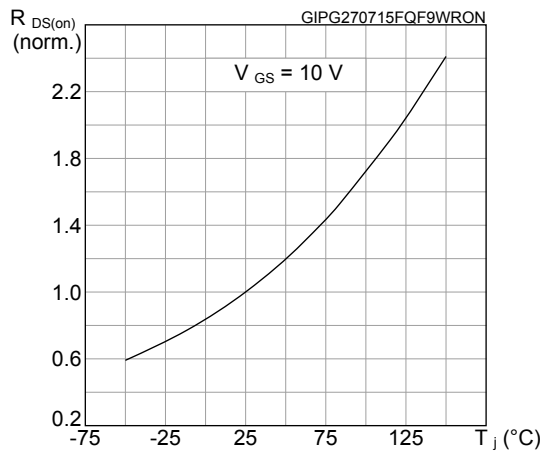
**Figure 7. Capacitance variations**



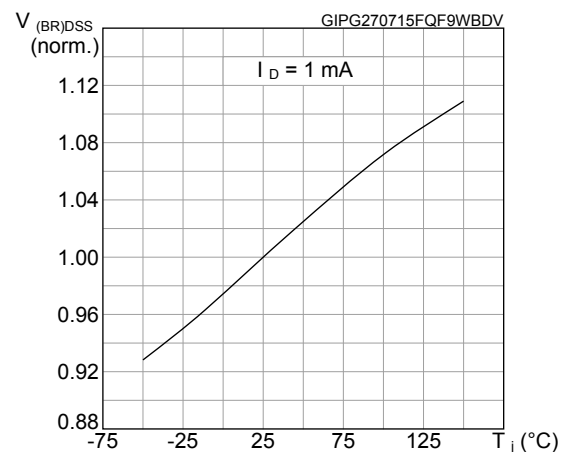
**Figure 8. Normalized gate threshold voltage vs temperature**



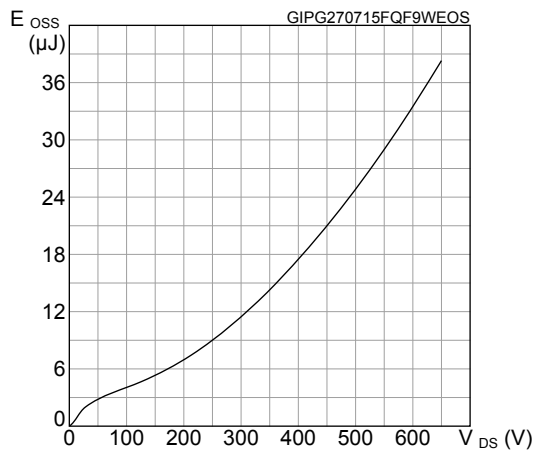
**Figure 9. Normalized on-resistance vs temperature**



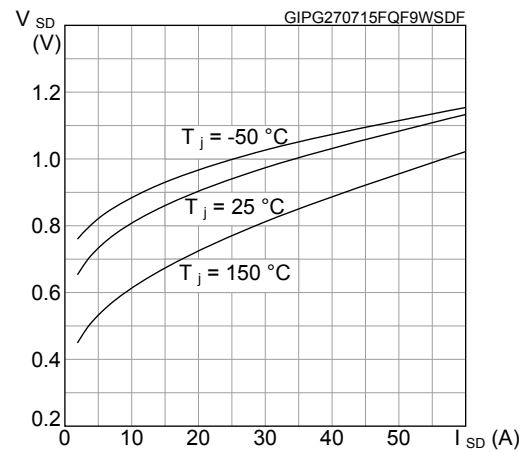
**Figure 10. Normalized  $V_{(BR)DSS}$  vs temperature**



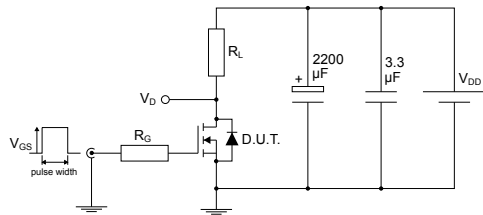
**Figure 11. Output capacitance stored energy**



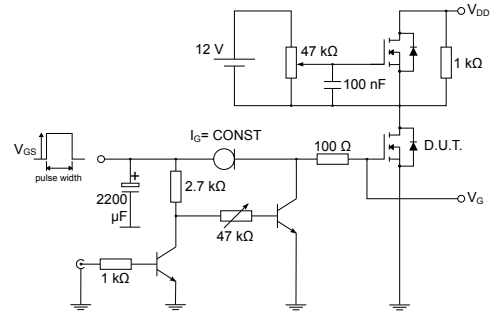
**Figure 12. Source-drain diode forward characteristics**



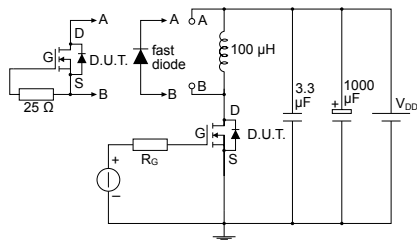
### 3 Test circuits

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


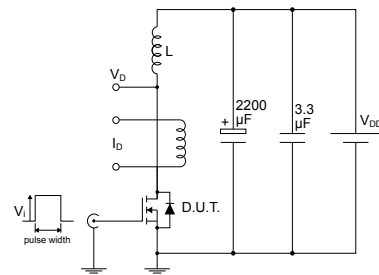
AM01468v1

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


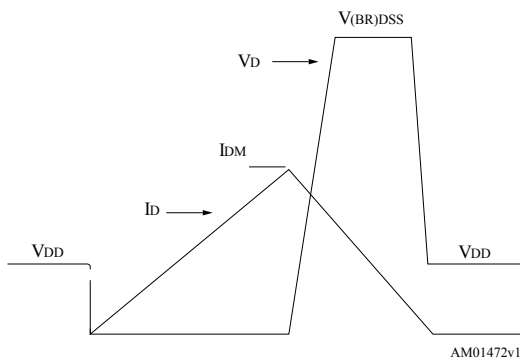
AM01469v1

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


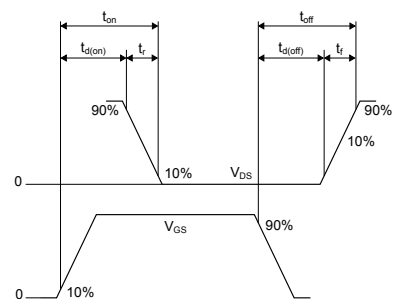
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**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


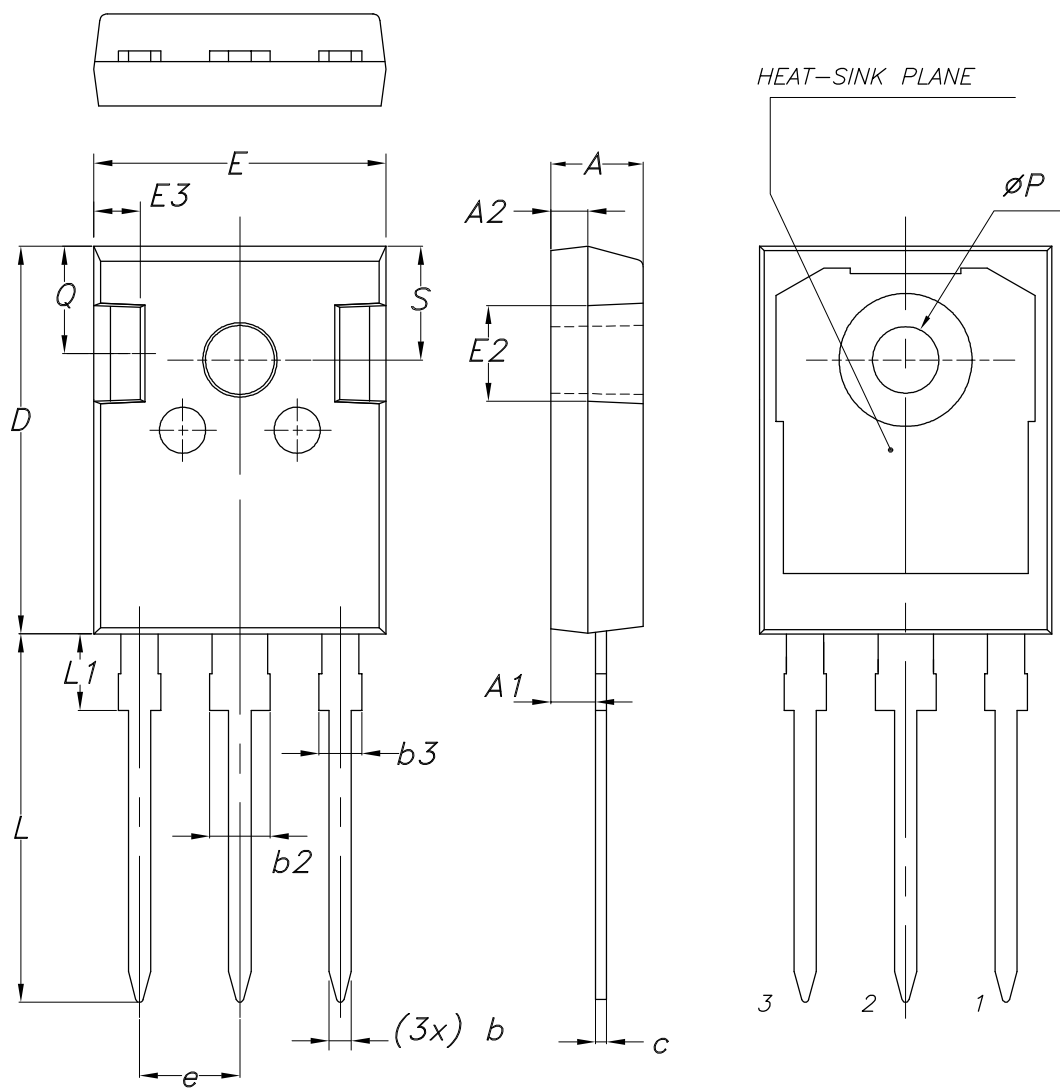
AM01473v1

## 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 long leads package information

**Figure 19. TO-247 long leads package outline**



8463846\_2\_F

**Table 8. 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 9. Document revision history**

| Date        | Revision | Changes                                                     |
|-------------|----------|-------------------------------------------------------------|
| 16-Apr-2018 | 1        | Initial release.<br>The document status is production data. |

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