

## N-channel 950 V, 0.110 $\Omega$ typ., 38 A MDmesh™ K5 Power MOSFET in a TO-247 long leads package

Datasheet - production data

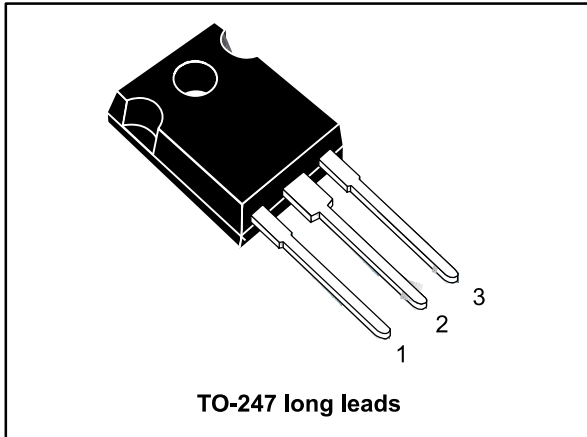
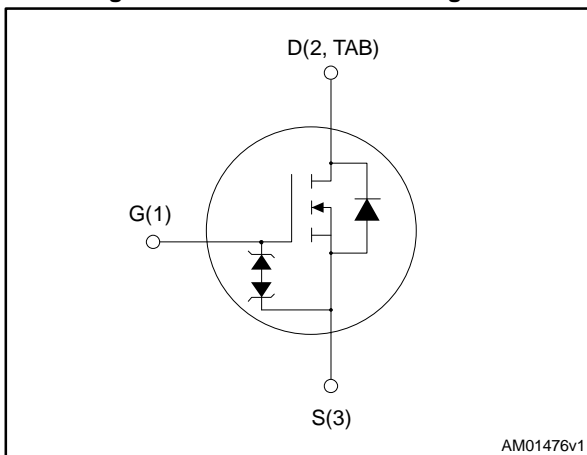


Figure 1: Internal schematic diagram



### Features

| Order code  | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> | P <sub>TOT</sub> |
|-------------|-----------------|-------------------------|----------------|------------------|
| STWA40N95K5 | 950 V           | 0.130 $\Omega$          | 38 A           | 450 W            |

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1: Device summary

| Order code  | Marking | Package | Packaging |
|-------------|---------|---------|-----------|
| STWA40N95K5 | 40N95K5 | TO-247  | Tube      |

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## Contents

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol                             | Parameter   | Value      | Unit |
|------------------------------------|---|------------|------|
| V <sub>GS</sub>                    | Gate- source voltage  | ± 30       | V    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 25 °C  | 38         | A    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 100 °C   | 24         | A    |
| I <sub>DM</sub> <sup>(1)</sup>     | Drain current (pulsed)  | 152        | A    |
| P <sub>TOT</sub>                   | Total dissipation at T <sub>C</sub> = 25 °C   | 450        | W    |
| I <sub>AR</sub>                    | Max current during repetitive or single pulse avalanche   | 13         | A    |
| E <sub>AS</sub>                    | Single pulse avalanche energy<br>(starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = 13 A, V <sub>DD</sub> = 50 V) | 700        | mJ   |
| dv/dt <sup>(2)</sup>               | Peak diode recovery voltage slope   | 4.5        | V/ns |
| dv/dt <sup>(3)</sup>               | MOSFET dv/dt ruggedness   | 50         | V/ns |
| T <sub>j</sub><br>T <sub>stg</sub> | Operating junction temperature<br>Storage temperature   | -55 to 150 | °C   |

**Notes:**

(1)Pulse width limited by safe operating area.

(2)I<sub>SD</sub> ≤ 19 A, di/dt ≤ 100 A/μs, V<sub>DS(peak)</sub> ≤ V<sub>(BR)DSS</sub>.

(3)V<sub>DS</sub> ≤ 760 V

Table 3: Thermal data

| Symbol                | Parameter                            | Value | Unit |
|-----------------------|--------------------------------------|-------|------|
| R <sub>thj-case</sub> | Thermal resistance junction-case max | 0.28  | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-amb max  | 50    | °C/W |

## 2 Electrical characteristics

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

**Table 4: On /off states**

| Symbol                      | Parameter                         | Test conditions   | Min. | Typ.  | Max.     | Unit          |
|-----------------------------|-----------------------------------|---|------|-------|----------|---------------|
| $V_{(\text{BR})\text{DSS}}$ | Drain-source breakdown voltage    | $V_{\text{GS}} = 0, I_{\text{D}} = 1\text{ mA}$                                 | 950  |       |          | V             |
| $I_{\text{DSS}}$            | Zero gate voltage drain current   | $V_{\text{GS}} = 0, V_{\text{DS}} = 950\text{ V}$                               |      |       | 1        | $\mu\text{A}$ |
|                             |                                   | $V_{\text{GS}} = 0, V_{\text{DS}} = 950\text{ V}, T_{\text{C}} = 125\text{ °C}$ |      |       | 50       | $\mu\text{A}$ |
| $I_{\text{GSS}}$            | Gate-body leakage current         | $V_{\text{DS}} = 0, V_{\text{GS}} = \pm 20\text{ V}$                            |      |       | $\pm 10$ | $\mu\text{A}$ |
| $V_{\text{GS(th)}}$         | Gate threshold voltage            | $V_{\text{DS}} = V_{\text{GS}}, I_{\text{D}} = 100\text{ }\mu\text{A}$          | 3    | 4     | 5        | V             |
| $R_{\text{DS(on)}}$         | Static drain-source on-resistance | $V_{\text{GS}} = 10\text{ V}, I_{\text{D}} = 19\text{ A}$                       |      | 0.110 | 0.130    | $\Omega$      |

**Table 5: Dynamic**

| Symbol                   | Parameter                             | Test conditions   | Min. | Typ. | Max. | Unit     |
|--------------------------|---------------------------------------|---|------|------|------|----------|
| $C_{\text{iss}}$         | Input capacitance                     | $V_{\text{GS}} = 0, V_{\text{DS}} = 100\text{ V}, f = 1\text{ MHz}$   | -    | 3300 | -    | pF       |
| $C_{\text{oss}}$         | Output capacitance                    |   | -    | 250  | -    | pF       |
| $C_{\text{rss}}$         | Reverse transfer capacitance          |   | -    | 2    | -    | pF       |
| $C_{\text{o(tr)}^{(1)}}$ | Equivalent capacitance time related   | $V_{\text{GS}} = 0, V_{\text{DS}} = 0\text{ to }760\text{ V}$   | -    | 398  | -    | pF       |
| $C_{\text{o(er)}^{(2)}}$ | Equivalent capacitance energy related |   | -    | 142  | -    | pF       |
| $R_{\text{G}}$           | Intrinsic gate resistance             | $f = 1\text{ MHz}, I_{\text{D}} = 0$  | -    | 5    | -    | $\Omega$ |
| $Q_{\text{g}}$           | Total gate charge                     | $V_{\text{DD}} = 760\text{ V}, I_{\text{D}} = 38\text{ A}$<br>$V_{\text{GS}} = 10\text{ V}$<br>(see <a href="#">Figure 16: "Gate charge test circuit"</a> ) | -    | 93   | -    | nC       |
| $Q_{\text{gs}}$          | Gate-source charge                    |   | -    | 18.7 | -    | nC       |
| $Q_{\text{gd}}$          | Gate-drain charge                     |   | -    | 63.4 | -    | nC       |

**Notes:**

<sup>(1)</sup>Time related 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%  $V_{\text{DSS}}$

<sup>(2)</sup>energy related is defined as a constant equivalent capacitance giving the same stored energy 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  | $V_{\text{DD}} = 475\text{ V}, I_{\text{D}} = 19\text{ A},$<br>$R_{\text{G}} = 4.7\text{ }\Omega, V_{\text{GS}} = 10\text{ V}$<br>(see <a href="#">Figure 15: "Switching times test circuit for resistive load"</a> ) | -    | 33.5 | -   | ns   |
| $t_{\text{r}}$      | Rise time           |   | -    | 51   | -   | ns   |
| $t_{\text{d(off)}}$ | Turn-off-delay time |   | -    | 91.5 | -   | ns   |
| $t_{\text{f}}$      | Fall time           |   | -    | 10   | -   | ns   |

Table 7: Source drain diode

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max | Unit          |
|-----------------|-------------------------------|--|------|------|-----|---------------|
| $I_{SD}$        | Source-drain current          |  | -    |      | 38  | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  | -    |      | 152 | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 38\text{ A}$ , $V_{GS} = 0$  | -    |      | 1.5 | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 38\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$<br>(see <a href="#">Figure 18: "Unclamped inductive load test circuit"</a> )                                     | -    | 706  |     | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 22   |     | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 62   |     | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 38\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 18: "Unclamped inductive load test circuit"</a> ) | -    | 886  |     | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 28.2 |     | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 64   |     | A             |

**Notes:**

(1)Pulse width limited by safe operating area.

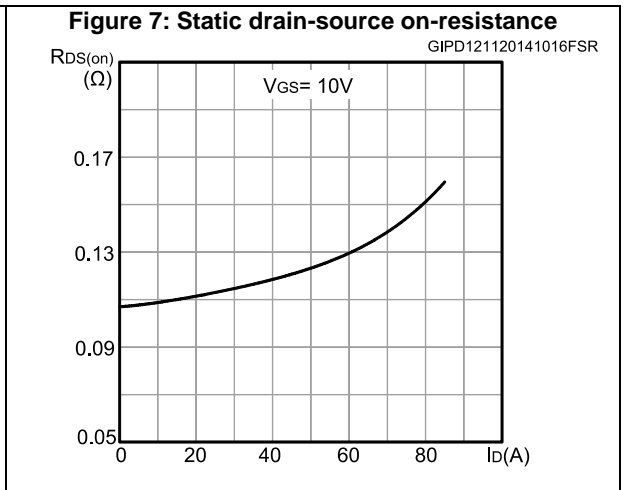
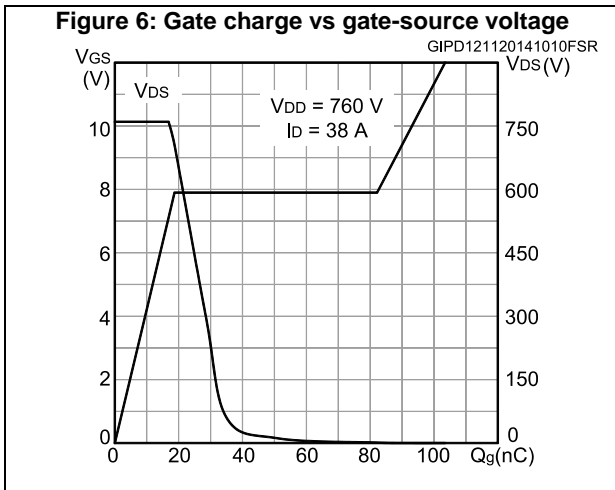
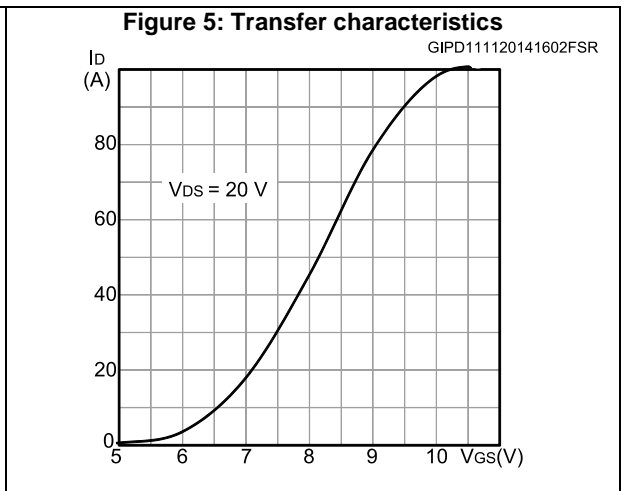
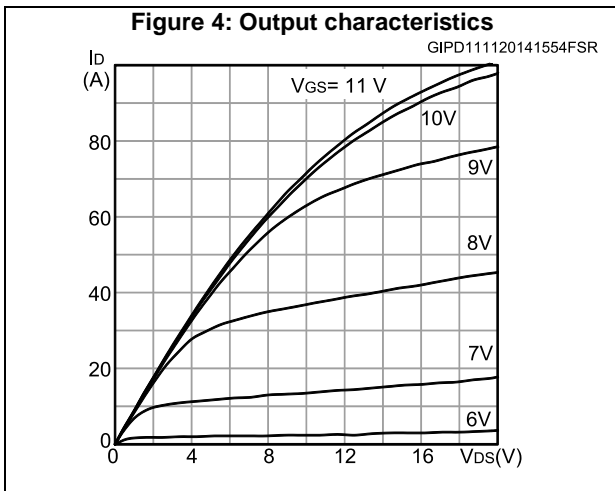
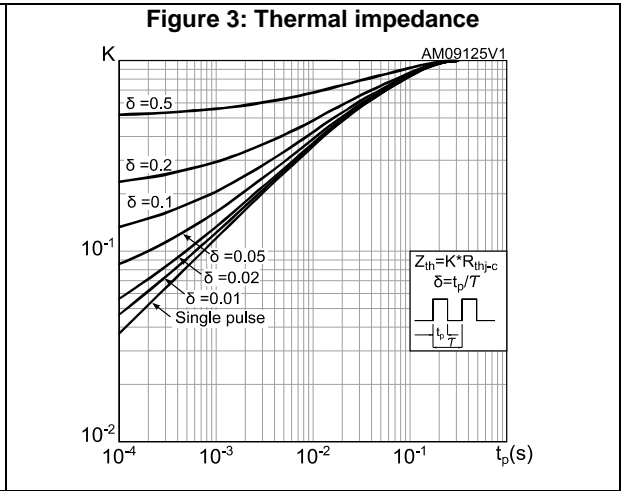
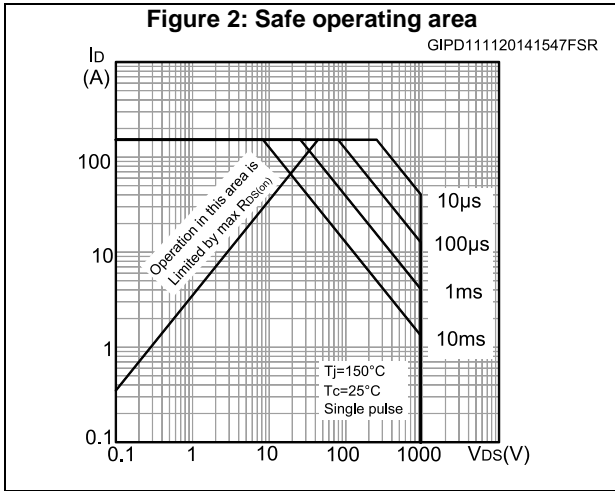
(2)Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

Table 8: Gate-source Zener diode

| Symbol        | Parameter                     | Test conditions                        | Min | Typ. | Max. | Unit |
|---------------|-------------------------------|--|-----|------|------|------|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage | $I_{GS} = \pm 1\text{ mA}$ , $I_D = 0$ | 30  | -    | -    | V    |

The built-in back-to-back Zener diodes have specifically been designed to enhance the device's ESD capability. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)



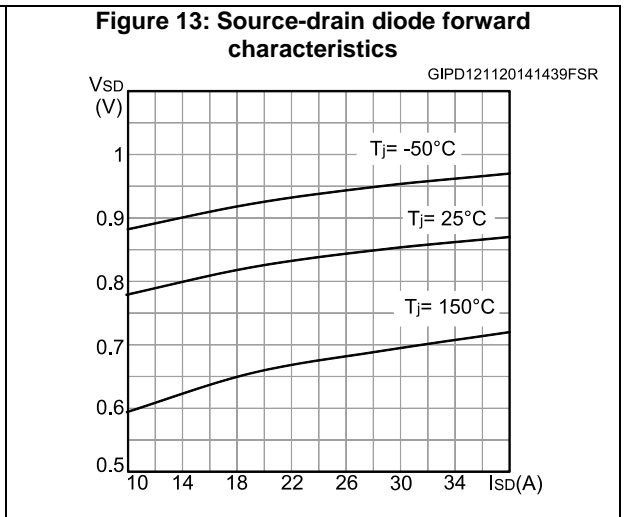
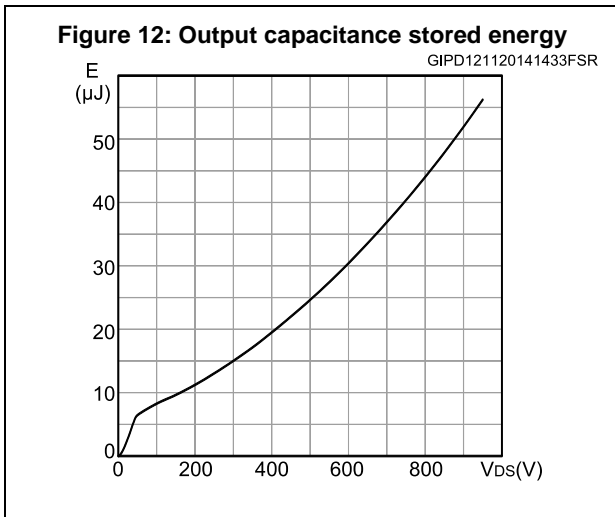
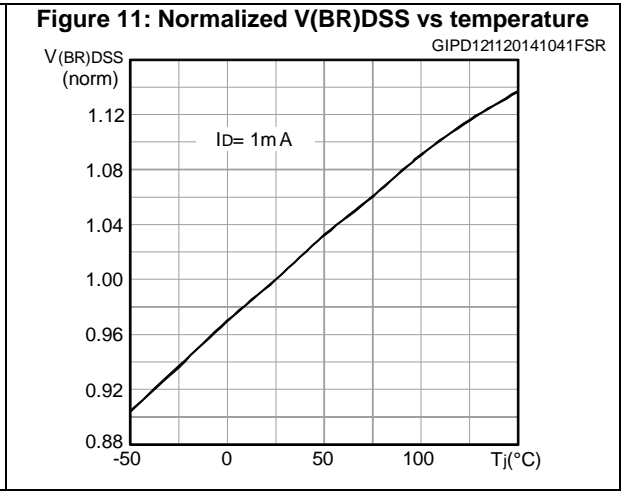
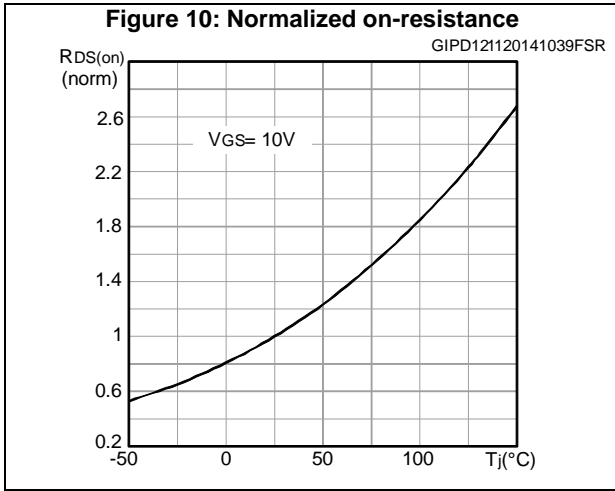
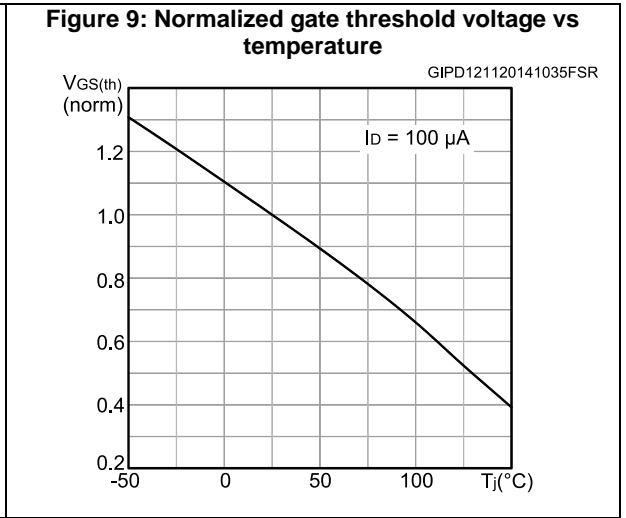
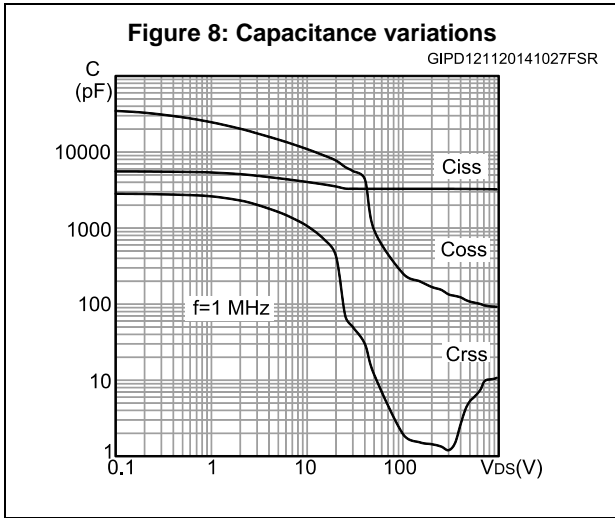
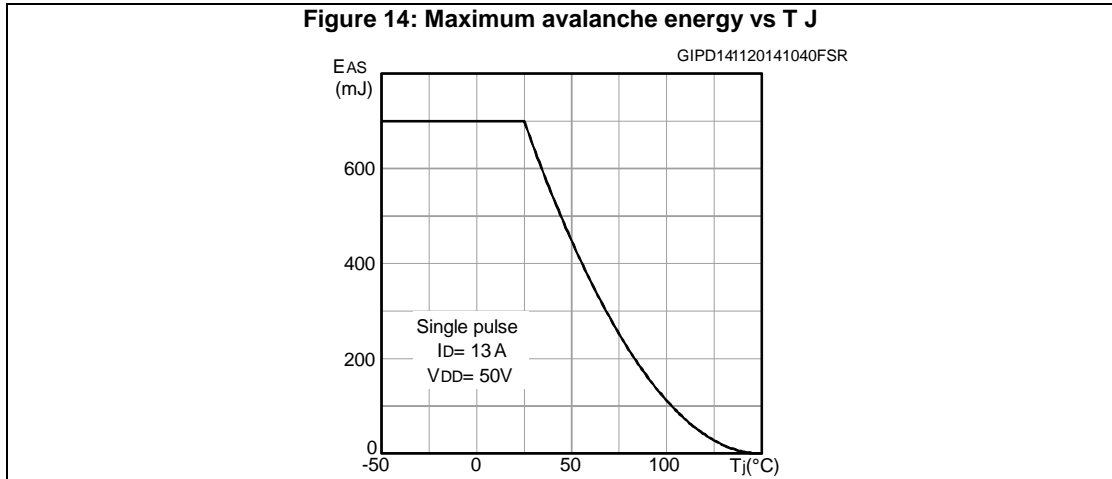
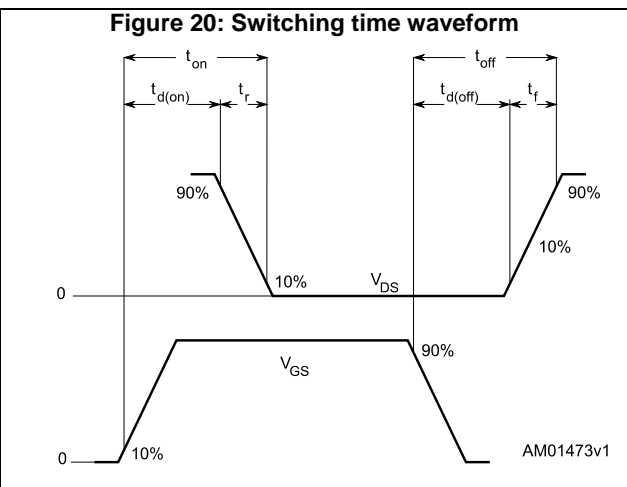
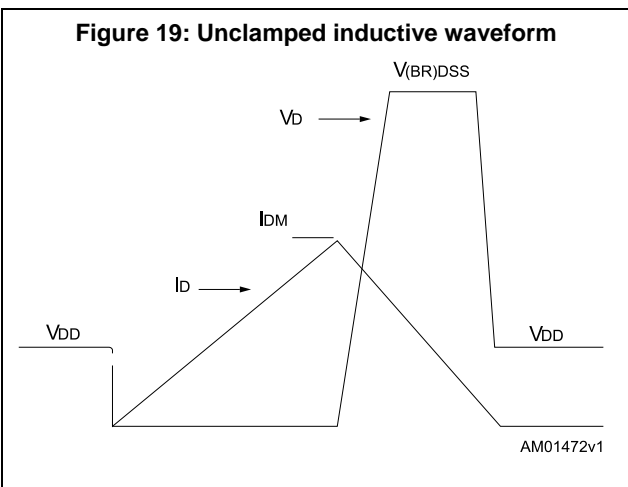
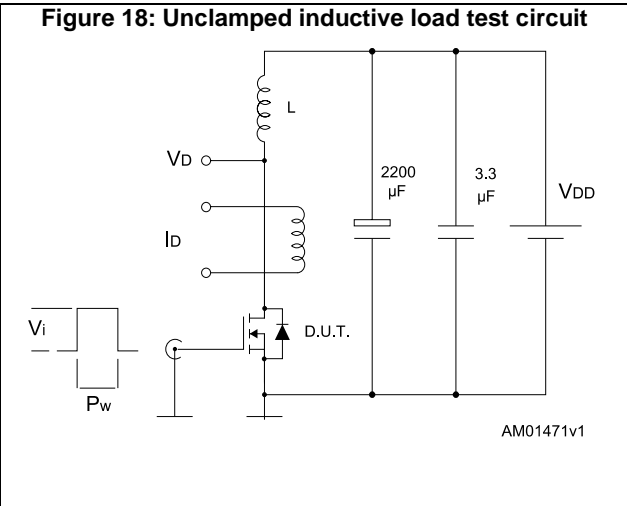
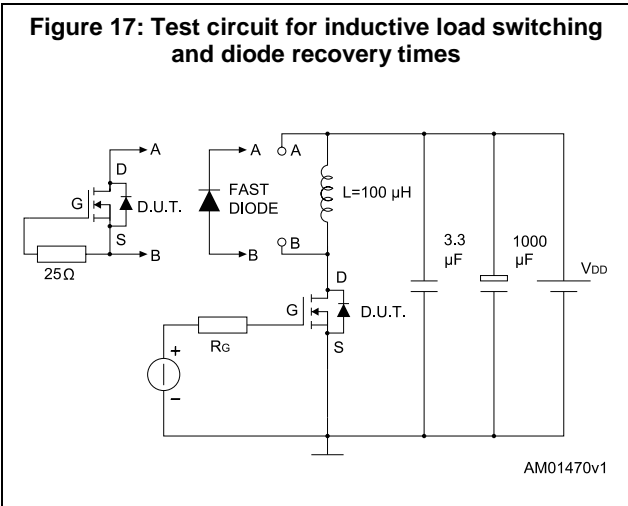
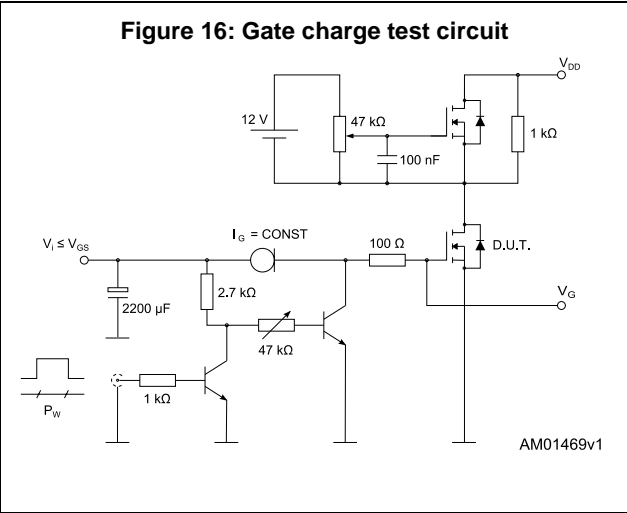
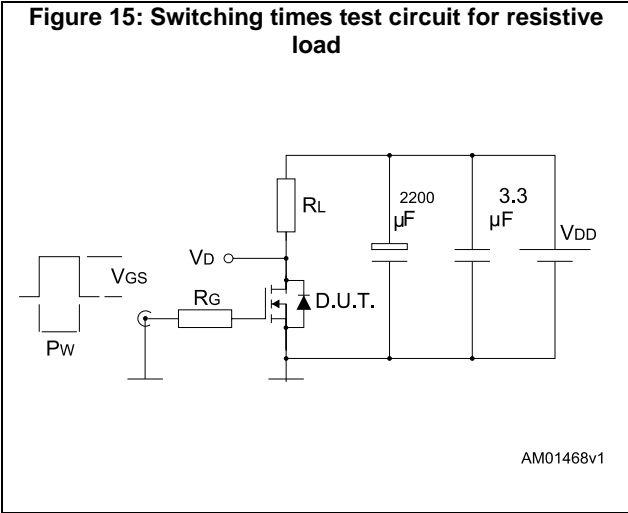


Figure 14: Maximum avalanche energy vs T J





### 3 Test circuits



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

### 4.1 TO-247 long leads package information

Figure 21: TO-247 long leads package outline

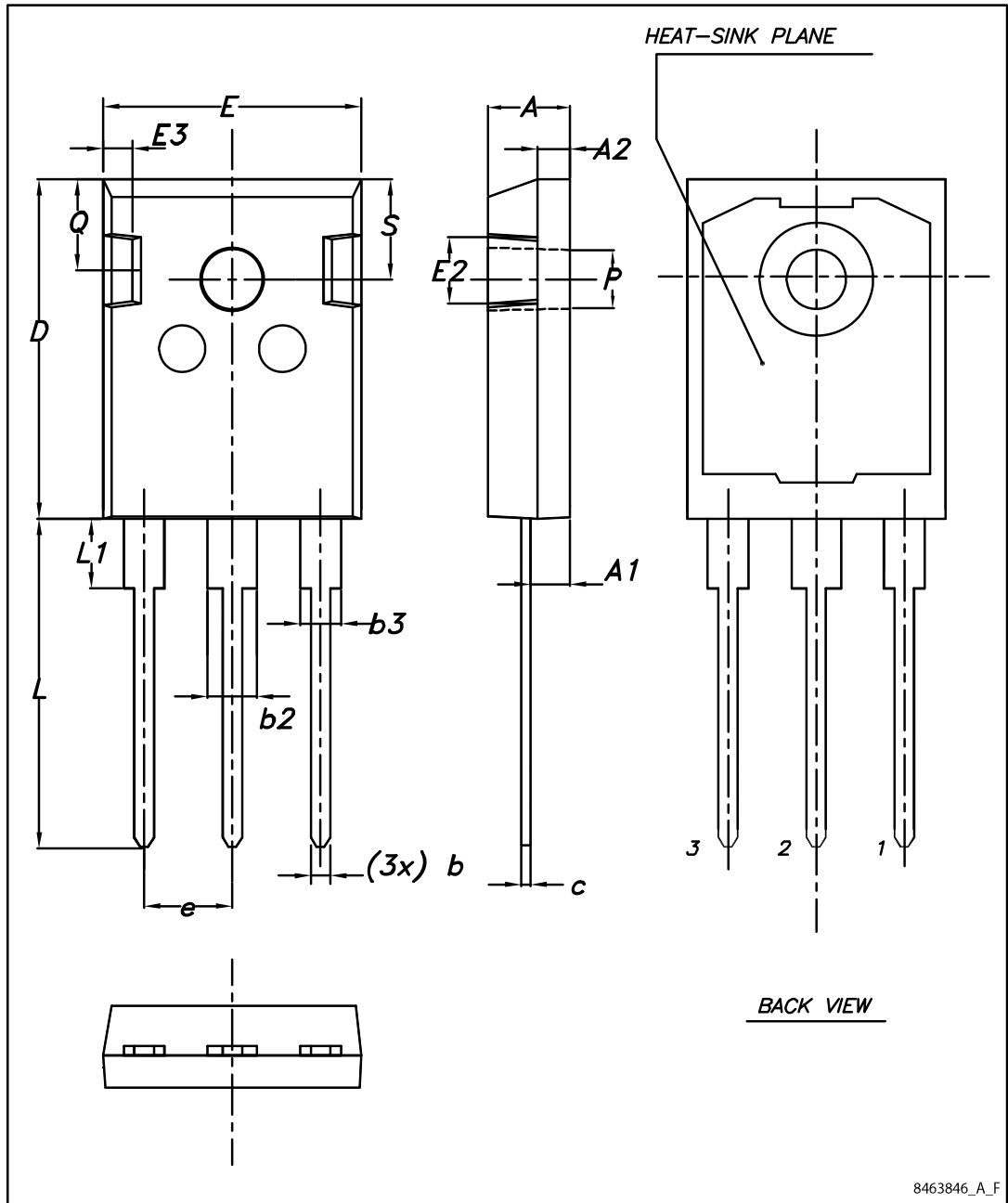


Table 9: TO-247 long leads package mechanical data

| 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  |

## 5 Revision history

Table 10: Document revision history

| Date        | Revision | Changes        |
|-------------|----------|----------------|
| 05-Aug-2015 | 1        | First release. |

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