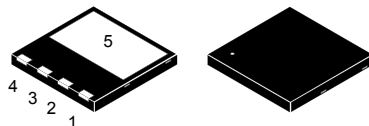
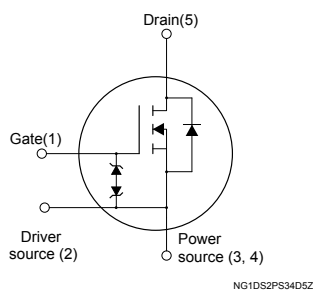


## N-channel 600 V, 70 mΩ typ., 31 A MDmesh™ M6 Power MOSFET in a PowerFLAT™ 8x8 HV package



PowerFLAT™ 8x8 HV



### Product status link

[STL47N60M6](#)

### Product summary

|            |                   |
|------------|-------------------|
| Order code | STL47N60M6        |
| Marking    | 47N60M6           |
| Package    | PowerFLAT™ 8x8 HV |
| Packing    | Tape and reel     |

## Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|------------|-----------------|--------------------------|----------------|
| STL47N60M6 | 600 V           | 82 mΩ                    | 31 A           |

- Reduced switching losses
- Lower R<sub>DS(on)</sub> x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected
- Excellent switching performance thanks to the extra driving source pin

## Applications

- Switching applications

## Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent R<sub>DS(on)</sub> per area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

# 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 $T_C = 25\text{ }^{\circ}\text{C}$  | 31         | A                  |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 20         | A                  |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                            | 124        | A                  |
| $P_{TOT}$      | Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$     | 190        | W                  |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                                 | 15         | V/ns               |
| $dv/dt^{(3)}$  | MOSFET $dv/dt$ ruggedness                                         | 100        | V/ns               |
| $T_{stg}$      | Storage temperature range                                         | -55 to 150 | $^{\circ}\text{C}$ |
| $T_j$          | Operating junction temperature range                              |            |                    |

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 31\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$
3.  $V_{DS} \leq 480\text{ V}$

**Table 2. Thermal data**

| Symbol              | Parameter                        | Value | Unit                        |
|---------------------|----------------------------------|-------|-----------------------------|
| $R_{thj-case}$      | Thermal resistance junction-case | 0.66  | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb  | 50    | $^{\circ}\text{C}/\text{W}$ |

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

**Table 3. Avalanche characteristics**

| Symbol   | Parameter                                                                                                                 | Value | Unit |
|----------|---------------------------------------------------------------------------------------------------------------------------|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive<br>(pulse width limited by $T_{jmax}$ )                                   | 5.3   | A    |
| $E_{AS}$ | Single pulse avalanche energy<br>(starting $T_j = 25\text{ }^{\circ}\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 800   | 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   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$                                             |      |      | 1       | $\mu\text{A}$    |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$ |      |      | 100     | $\mu\text{A}$    |
| $I_{GSS}$     | 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 | $V_{GS} = 10\text{ V}$ , $I_D = 15.5\text{ A}$                                              |      | 70   | 82      | $\text{m}\Omega$ |

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

**Table 5. Dynamic**

| Symbol                     | Parameter                     | Test conditions                                                                                                                              | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$                  | Input capacitance             | $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$                                                                         | -    | 2340 | -    | pF       |
| $C_{oss}$                  | Output capacitance            |                                                                                                                                              | -    | 149  | -    | pF       |
| $C_{rss}$                  | Reverse transfer capacitance  |                                                                                                                                              | -    | 3.7  | -    | pF       |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                  | -    | 390  | -    | pF       |
| $R_G$                      | Intrinsic gate resistance     | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$                                                                                                      | -    | 1.4  | -    | $\Omega$ |
| $Q_g$                      | Total gate charge             | $V_{DD} = 480\text{ V}$ , $I_D = 36\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$<br>(see Figure 14. Test circuit for gate charge behavior) | -    | 52.2 | -    | nC       |
| $Q_{gs}$                   | Gate-source charge            |                                                                                                                                              | -    | 16.5 | -    | nC       |
| $Q_{gd}$                   | Gate-drain charge             |                                                                                                                                              | -    | 23   | -    | 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 6. Switching times**

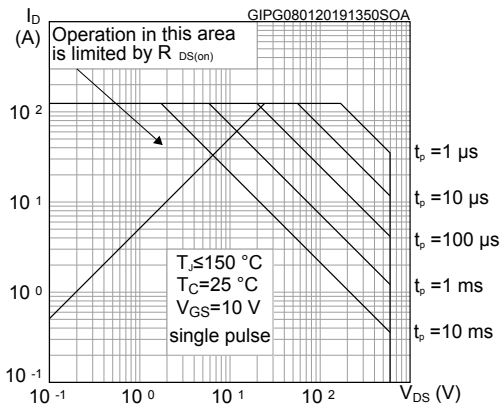
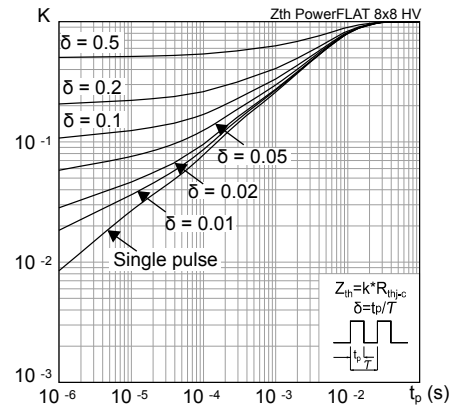
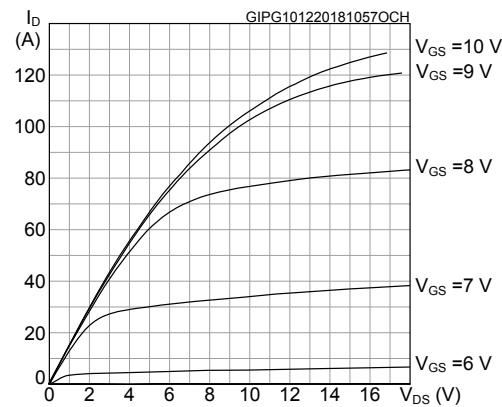
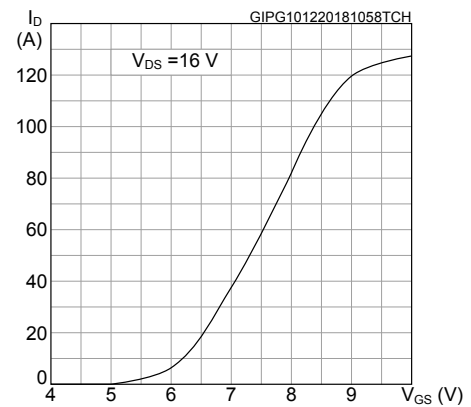
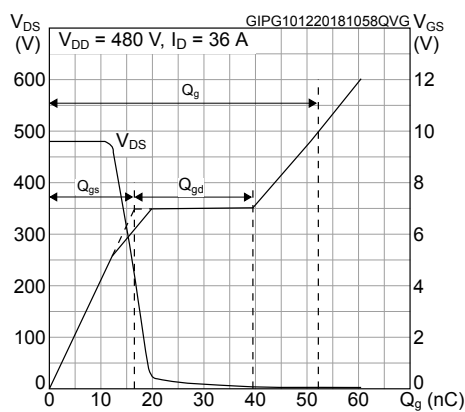
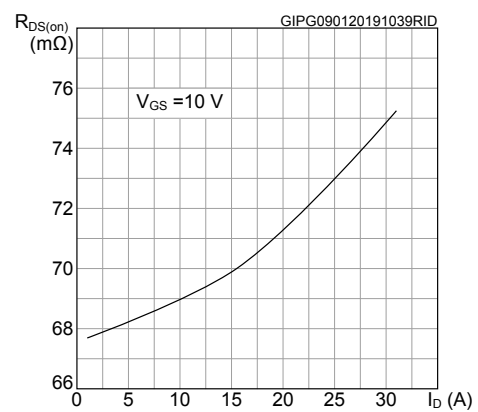
| Symbol       | Parameter           | Test conditions                                                                                                                                                                                                  | Min. | Typ. | Max. | Unit |
|--------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 300\text{ V}$ , $I_D = 18\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 13. Switching times test circuit for resistive load and Figure 18. Switching time waveform) | -    | 21.5 | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                                                                                                  | -    | 18.7 | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                                                                                                  | -    | 54.6 | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                                                                                                  | -    | 8.1  | -    | ns   |

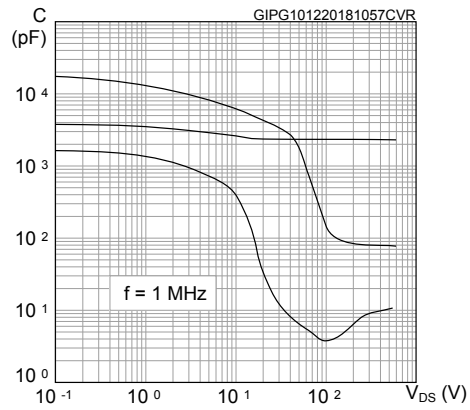
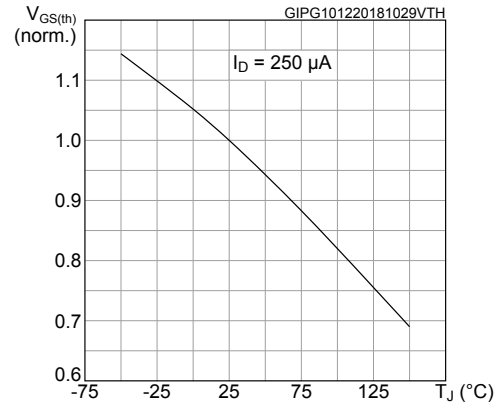
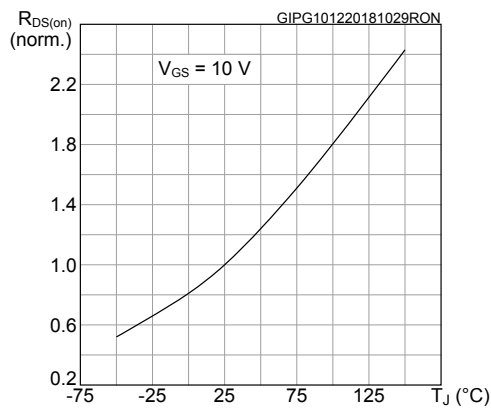
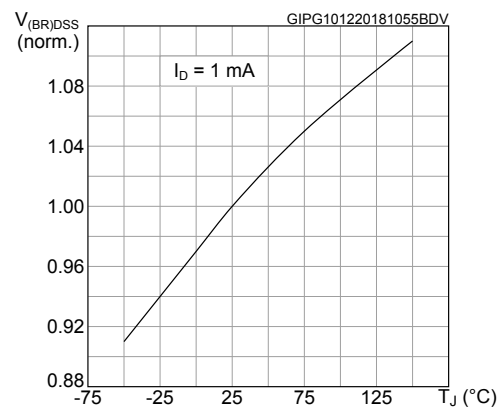
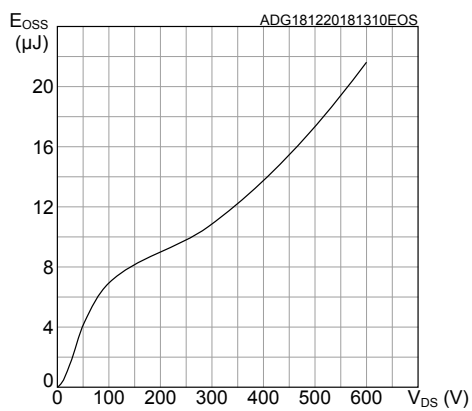
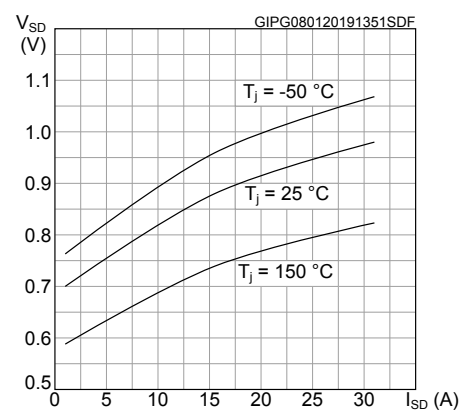
**Table 7. Source-drain diode**

| Symbol              | Parameter                     | Test conditions                                                                                                                                                                                                 | Min. | Typ. | Max. | Unit          |
|---------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}^{(1)}$      | Source-drain current          |                                                                                                                                                                                                                 | -    |      | 31   | A             |
| $I_{SDM}^{(2) (1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                 | -    |      | 124  | A             |
| $V_{SD}^{(3)}$      | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = 31\text{ A}$                                                                                                                                                                  | -    |      | 1.6  | V             |
| $t_{rr}$            | Reverse recovery time         | $I_{SD} = 36\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$<br>(see Figure 15. Test circuit for inductive load switching and diode recovery times)                                     | -    | 281  |      | ns            |
| $Q_{rr}$            | Reverse recovery charge       |                                                                                                                                                                                                                 | -    | 3.67 |      | $\mu\text{C}$ |
| $I_{RRM}$           | Reverse recovery current      |                                                                                                                                                                                                                 | -    | 26.1 |      | A             |
| $t_{rr}$            | Reverse recovery time         | $I_{SD} = 36\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ ,<br>$T_j = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times) | -    | 424  |      | ns            |
| $Q_{rr}$            | Reverse recovery charge       |                                                                                                                                                                                                                 | -    | 7.2  |      | $\mu\text{C}$ |
| $I_{RRM}$           | Reverse recovery current      |                                                                                                                                                                                                                 | -    | 34   |      | A             |

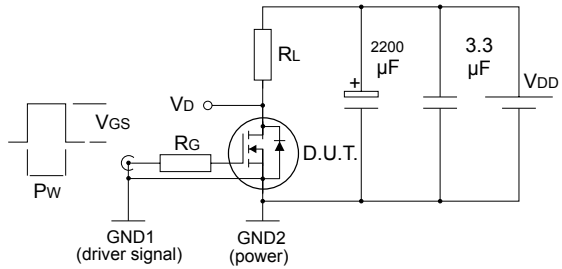
1. This value is limited by package.
2. Pulse width is limited by safe operating area.
3. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

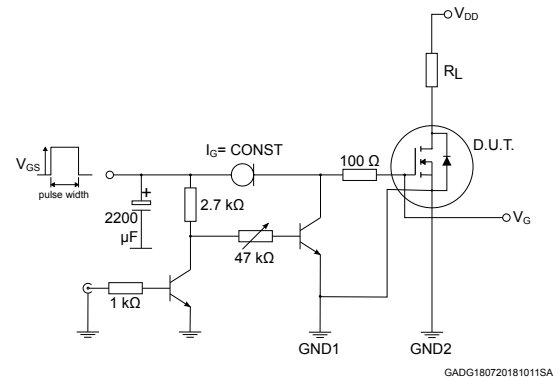
**Figure 1. Safe operating area**

**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. 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**


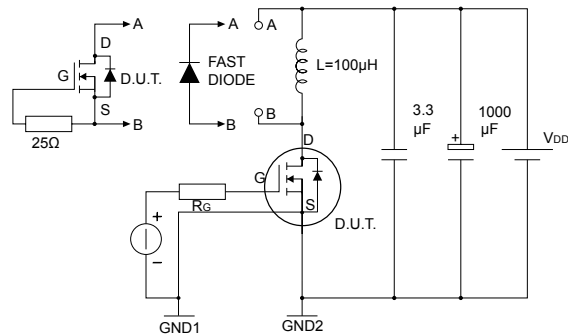
### 3 Test circuits

**Figure 13. Switching times test circuit for resistive load**


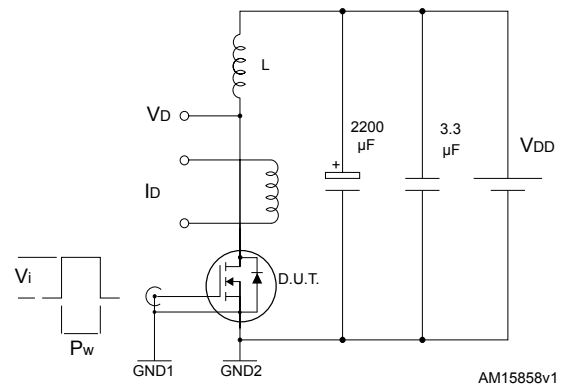
AM15855v1

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


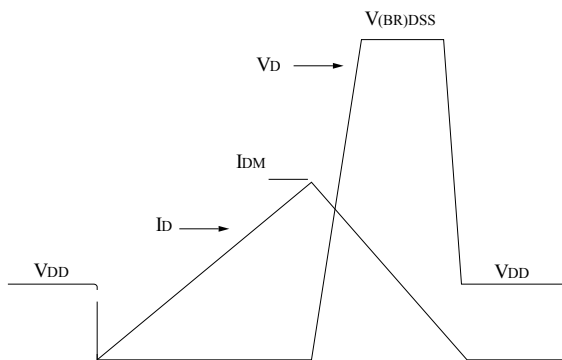
GADG180720181011SA

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


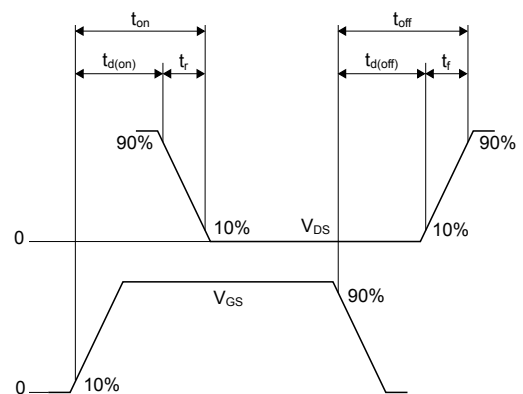
AM15857v1

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


AM15858v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

---

## 4 Package information

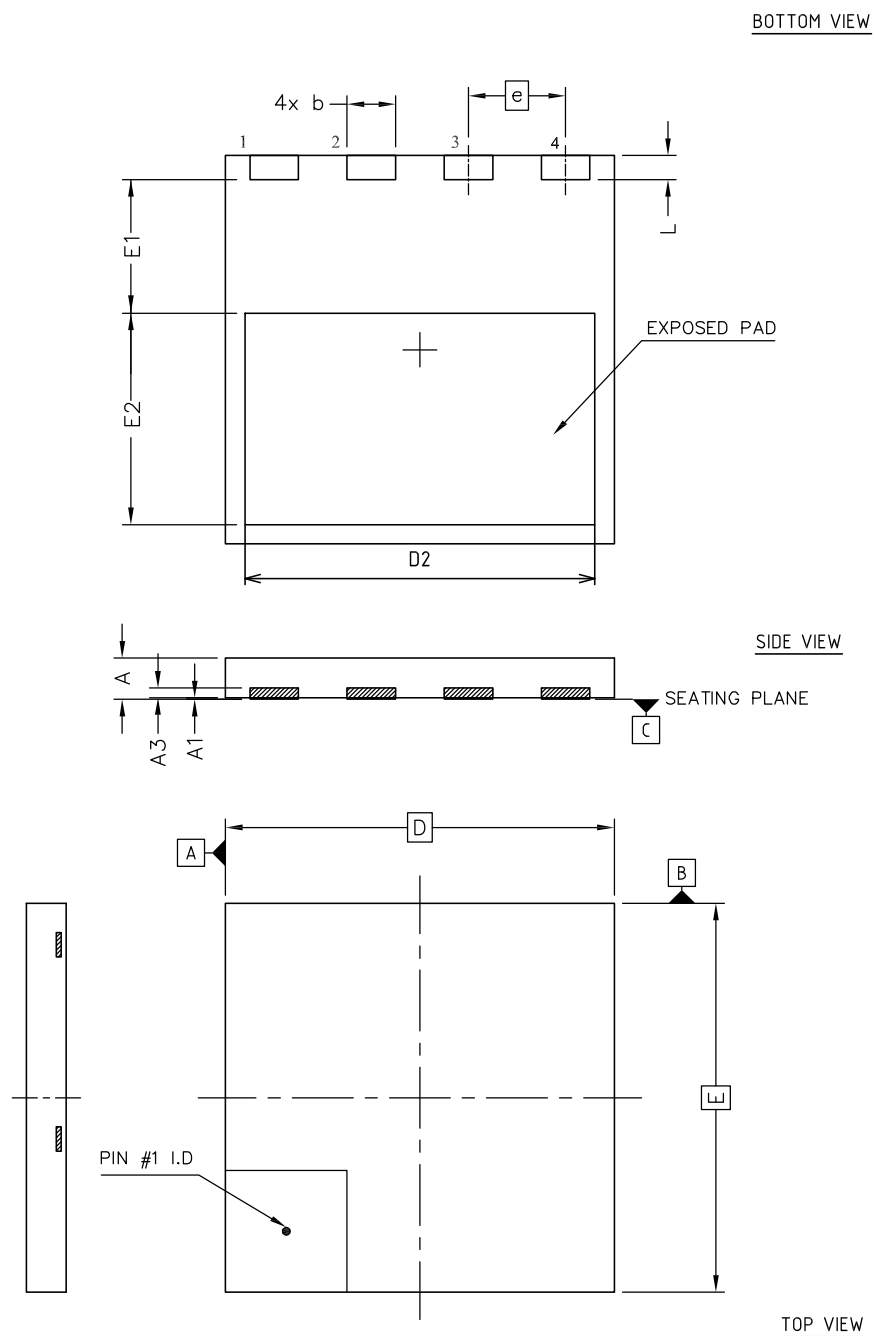
---

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 PowerFLAT™ 8x8 HV package information

Figure 19. PowerFLAT™ 8x8 HV package outline

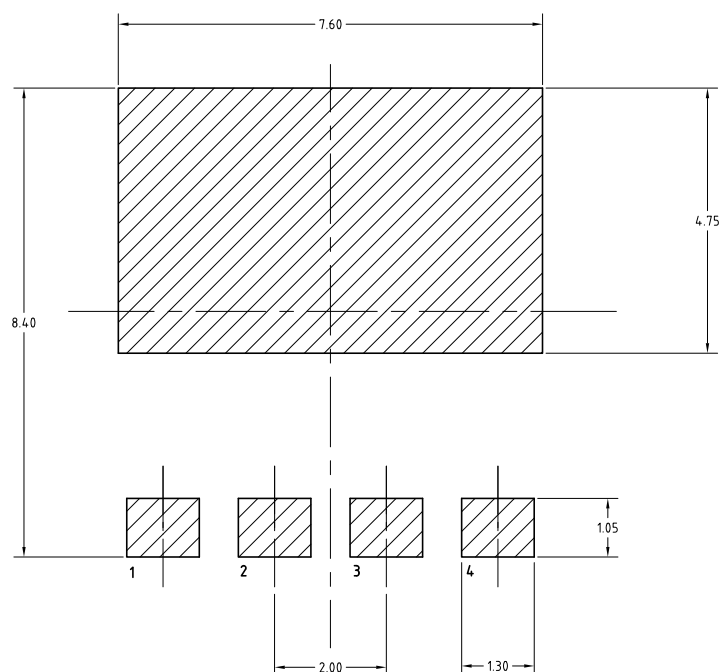


8222871\_Rev\_4

**Table 8. PowerFLAT™ 8x8 HV mechanical data**

| Ref. | Dimensions (in mm) |      |      |
|------|--------------------|------|------|
|      | Min.               | Typ. | Max. |
| A    | 0.75               | 0.85 | 0.95 |
| A1   | 0.00               |      | 0.05 |
| A3   | 0.10               | 0.20 | 0.30 |
| b    | 0.90               | 1.00 | 1.10 |
| D    | 7.90               | 8.00 | 8.10 |
| E    | 7.90               | 8.00 | 8.10 |
| D2   | 7.10               | 7.20 | 7.30 |
| E1   | 2.65               | 2.75 | 2.85 |
| E2   | 4.25               | 4.35 | 4.45 |
| e    | 2.00 BSC           |      |      |
| L    | 0.40               | 0.50 | 0.60 |

**Figure 20. PowerFLAT™ 8x8 HV footprint**

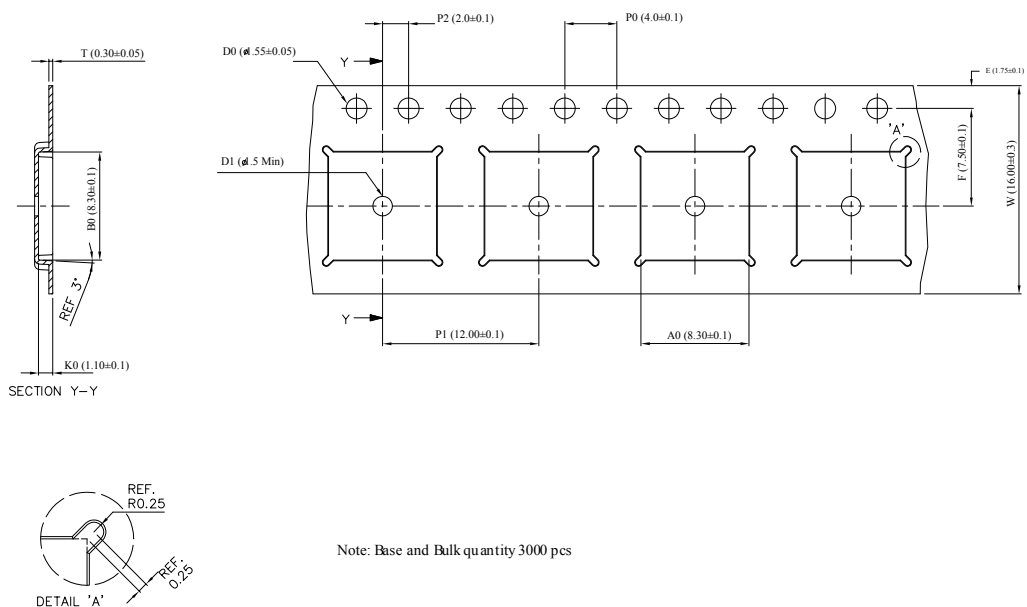


8222871\_REV\_4\_footprint

**Note:** All dimensions are in millimeters.

## 4.2 PowerFLAT™ 8x8 HV packing information

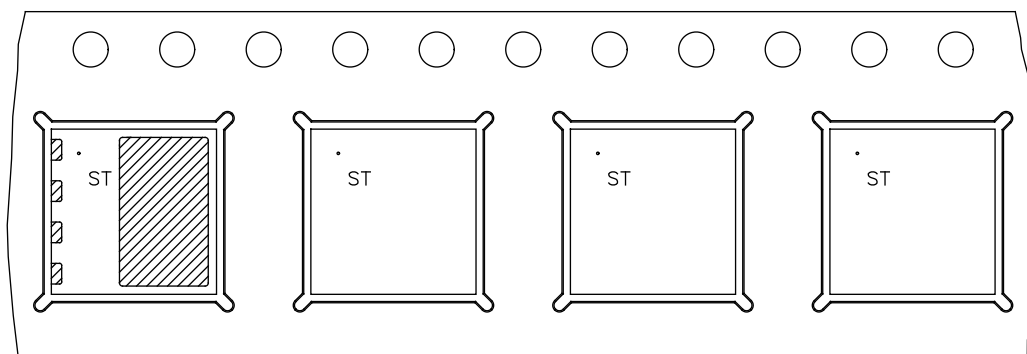
Figure 21. PowerFLAT™ 8x8 HV tape



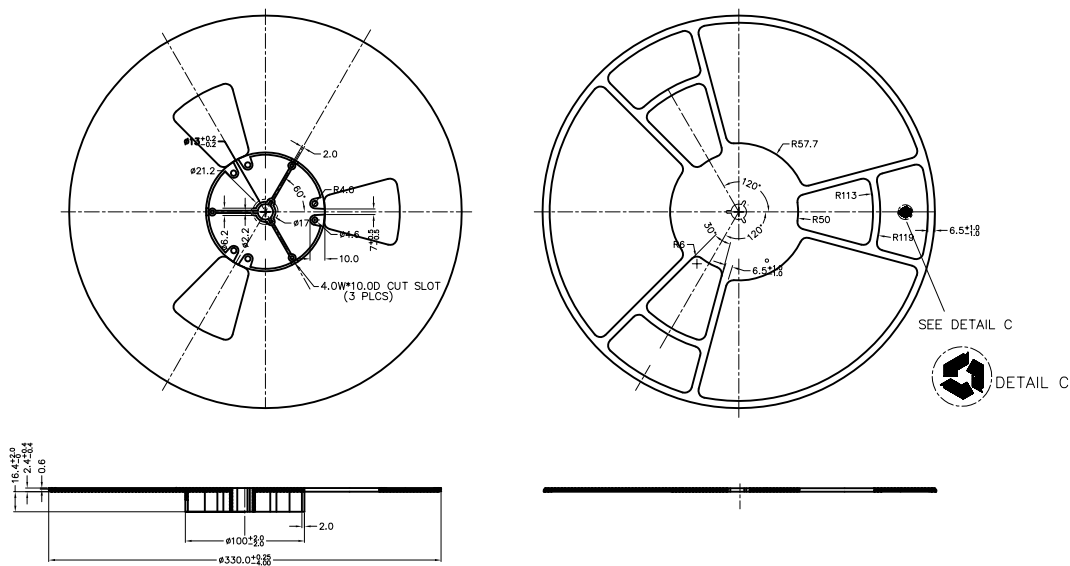
8229819\_Tape\_revA

Note: All dimensions are in millimeters.

Figure 22. PowerFLAT™ 8x8 HV package orientation in carrier tape



**Figure 23. PowerFLAT™ 8x8 HV reel**



8229819\_Reel\_revA

**Note:** All dimensions are in millimeters.

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15-Nov-2017 | 1        | First release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 22-Jan-2019 | 2        | <p>Modified <a href="#">Table 1. Absolute maximum ratings</a>, <a href="#">Table 2. Thermal data</a>, <a href="#">Table 3. Avalanche characteristics</a>, <a href="#">Table 4. On/off states</a>, <a href="#">Table 5. Dynamic</a>, <a href="#">Table 6. Switching times</a> and <a href="#">Table 7. Source-drain diode</a>.</p> <p>Added <a href="#">Section 2.1 Electrical characteristics (curves)</a>.</p> <p>Modified <a href="#">Section 3 Test circuits</a>.</p> <p>Minor text changes.</p> |

## Contents

|          |                                             |           |
|----------|---------------------------------------------|-----------|
| <b>1</b> | <b>Electrical ratings .....</b>             | <b>2</b>  |
| <b>2</b> | <b>Electrical characteristics.....</b>      | <b>3</b>  |
| 2.1      | Electrical characteristics (curves) .....   | 5         |
| <b>3</b> | <b>Test circuits .....</b>                  | <b>7</b>  |
| <b>4</b> | <b>Package information.....</b>             | <b>8</b>  |
| 4.1      | PowerFLAT 8x8 HV package information .....  | 8         |
| 4.2      | PowerFLAT™ 8x8 HV packing information ..... | 10        |
|          | <b>Revision history .....</b>               | <b>13</b> |

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2019 STMicroelectronics – All rights reserved

## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9