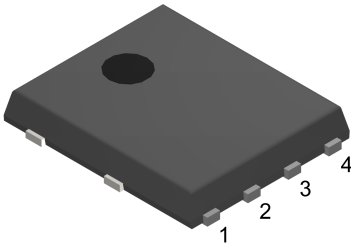
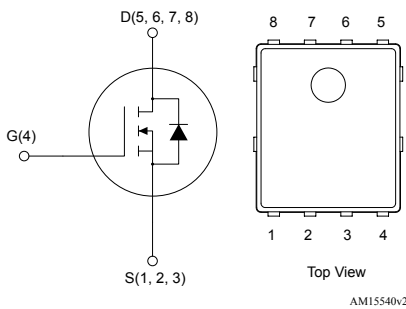


## N-channel 60 V, 1.2 mΩ typ., 120 A STripFET F7 Power MOSFET in a PowerFLAT 5x6 package


**PowerFLAT 5x6**


| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|------------|-----------------|--------------------------|----------------|
| STL220N6F7 | 60 V            | 1.4 mΩ                   | 120 A          |

- Among the lowest R<sub>DS(on)</sub> on the market
- Excellent FoM (figure of merit)
- Low C<sub>rss</sub>/C<sub>iss</sub> ratio for EMI immunity
- High avalanche ruggedness

### Applications

- Switching applications

### Description

This N-channel Power MOSFET utilizes STripFET F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching.



#### Product status link

[STL220N6F7](#)

#### Product summary

|                   |               |
|-------------------|---------------|
| <b>Order code</b> | STL220N6F7    |
| <b>Marking</b>    | 220N6F7       |
| <b>Package</b>    | PowerFLAT 5x6 |
| <b>Packing</b>    | Tape and reel |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol            | Parameter   | Value      | Unit             |
|-------------------|---|------------|------------------|
| $V_{DS}$          | Drain-source voltage  | 60         | V                |
| $V_{GS}$          | Gate-source voltage   | $\pm 20$   | V                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$                                      | 120        | A                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$                                     | 120        | A                |
| $I_{DM}^{(2)(1)}$ | Drain current (pulsed)  | 480        | A                |
| $I_D^{(3)}$       | Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$                                  | 40         | A                |
| $I_D^{(3)}$       | Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$                                 | 28.5       | A                |
| $I_{DM}^{(2)(3)}$ | Drain current (pulsed)  | 160        | A                |
| $E_{AS}$          | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_{AS} = 20\text{ A}$ ) | 900        | mJ               |
| $P_{TOT}^{(1)}$   | Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$   | 188        | W                |
| $P_{TOT}^{(3)}$   | Total power dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$                                     | 4.8        | W                |
| $T_j$             | Operating junction temperature range  | -55 to 175 | $^\circ\text{C}$ |
|                   | Storage temperature range   |            |                  |

1. This value is rated according to  $R_{thj-c}$ .
2. Pulse width limited by safe operating area.
3. This value is rated according to  $R_{thj-pcb}$ .

**Table 2. Thermal data**

| Symbol              | Parameter                        | Value | Unit               |
|---------------------|----------------------------------|-------|--------------------|
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb  | 31.3  | $^\circ\text{C/W}$ |
| $R_{thj-case}$      | Thermal resistance junction-case | 0.8   | $^\circ\text{C/W}$ |

1. When mounted on FR-4 board of 1 inch<sup>2</sup>, 2oz Cu,  $t < 10\text{ s}$ .

## 2 Electrical characteristics

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

**Table 3. On /off states**

| Symbol        | Parameter                         | Test conditions                                    | Min. | Typ. | Max. | Unit          |
|---------------|-----------------------------------|--|------|------|------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$        | 60   |      |      | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0\text{ V}$<br>$V_{DS} = 60\text{ V}$    |      |      | 1    | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$     |      |      | 100  | nA            |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$ | 2    |      | 4    | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$       |      | 1.2  | 1.4  | m $\Omega$    |

**Table 4. Dynamic**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$                       | -    | 6500 | -    | pF   |
| $C_{oss}$ | Output capacitance           |   | -    | 3200 | -    | pF   |
| $C_{rss}$ | Reverse transfer capacitance |   | -    | 230  | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 30\text{ V}$ , $I_D = 40\text{ A}$ ,  | -    | 98   | -    | nC   |
| $Q_{gs}$  | Gate-source charge           | $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 13. Test circuit for gate charge behavior) | -    | 38   | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            |   | -    | 28   | -    | nC   |

**Table 5. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 30\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see and Figure 17. Switching time waveform) | -    | 41   | -    | ns   |
| $t_r$        | Rise time           |   | -    | 45   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |   | -    | 68   | -    | ns   |
| $t_f$        | Fall time           |   | -    | 35   | -    | ns   |

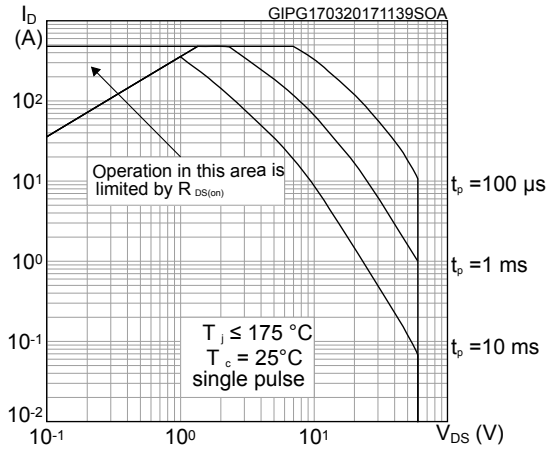
**Table 6. Source-drain diode**

| Symbol         | Parameter                | Test conditions  | Min. | Typ. | Max. | Unit |
|----------------|--------------------------|--|------|------|------|------|
| $V_{SD}^{(1)}$ | Forward on voltage       | $I_{SD} = 40\text{ A}$ , $V_{GS} = 0\text{ V}$   | -    |      | 1.2  | V    |
| $t_{rr}$       | Reverse recovery time    | $I_D = 40\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$   | -    | 69   |      | ns   |
| $Q_{rr}$       | Reverse recovery charge  | $V_{DD} = 48\text{ V}$ (see Figure 14. Test circuit for inductive load switching and diode recovery times) | -    | 103  |      | nC   |
| $I_{RRM}$      | Reverse recovery current |  | -    | 3    |      | A    |

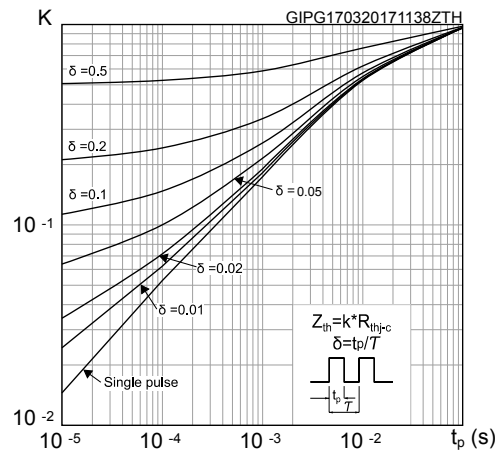
1. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

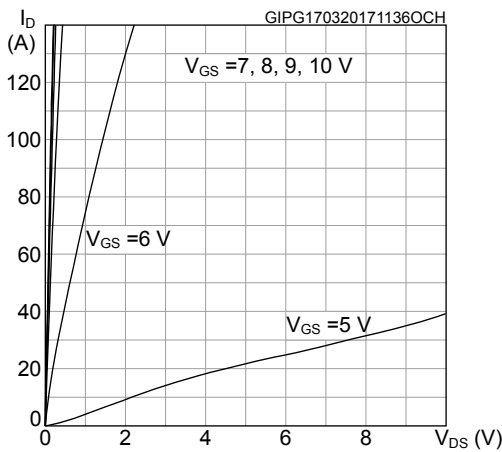
**Figure 1. Safe operating area**



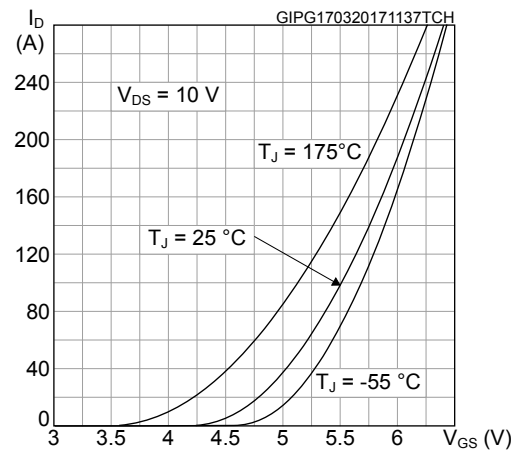
**Figure 2. Thermal impedance**



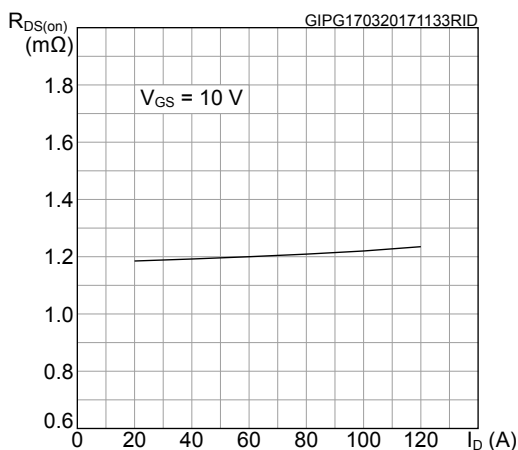
**Figure 3. Output characteristics**



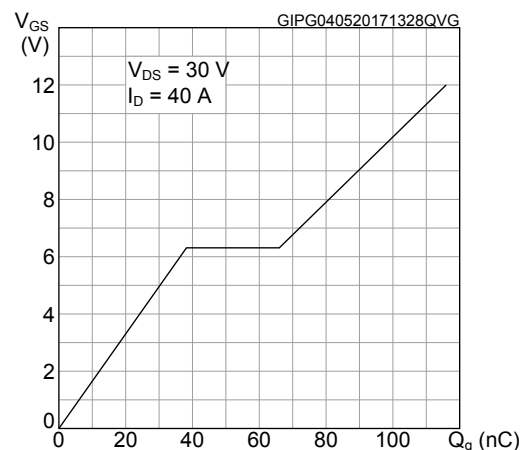
**Figure 4. Transfer characteristics**



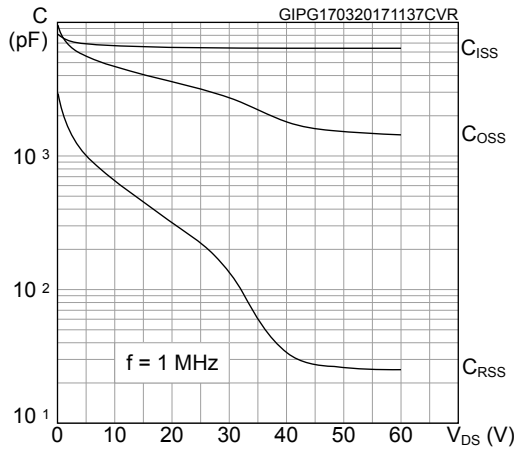
**Figure 5. Static drain-source on-resistance**



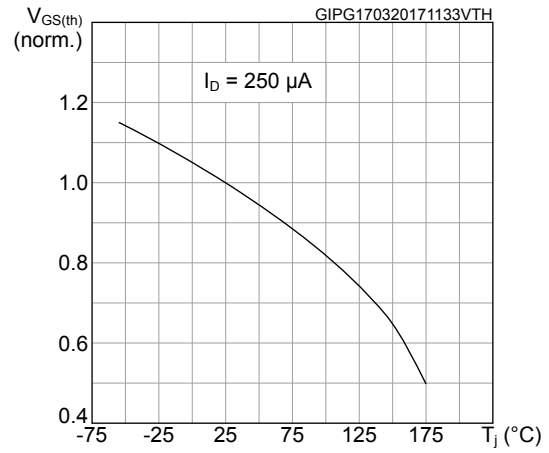
**Figure 6. Gate charge vs gate-source voltage**



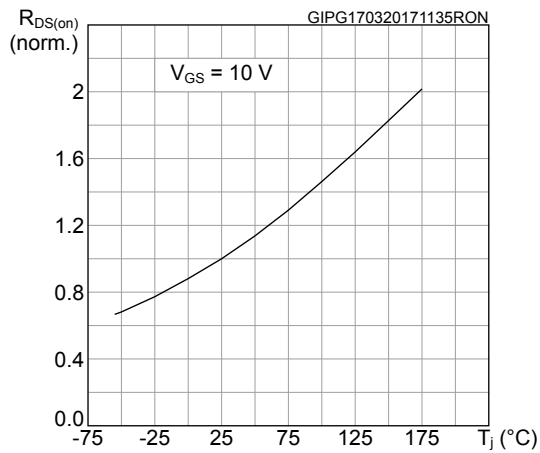
**Figure 7. Capacitance variations**



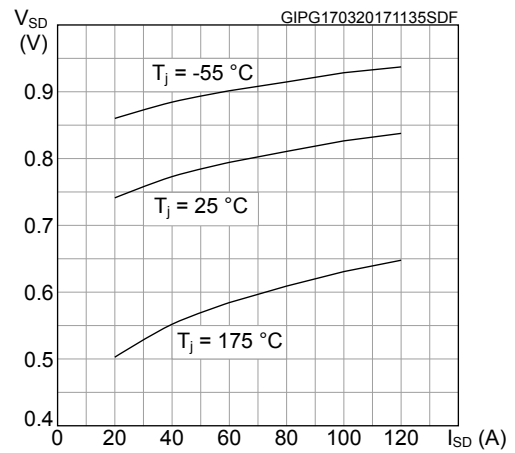
**Figure 8. Normalized gate threshold voltage vs temperature**



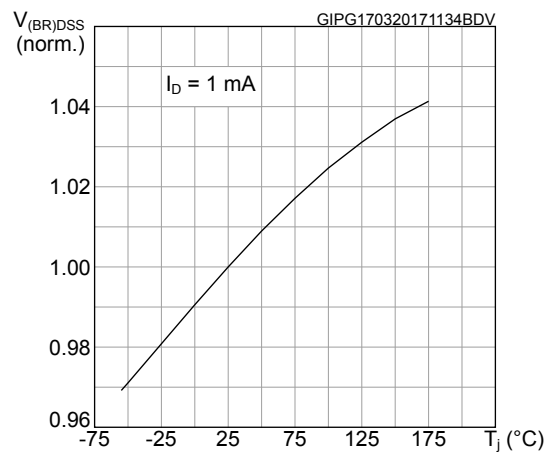
**Figure 9. Normalized on-resistance vs temperature**



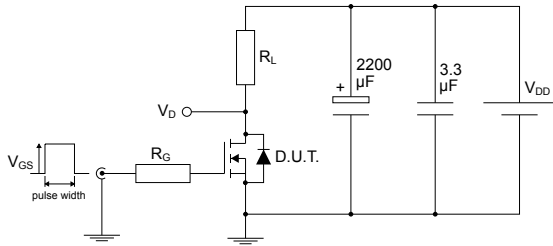
**Figure 10. Source-drain diode forward characteristics**



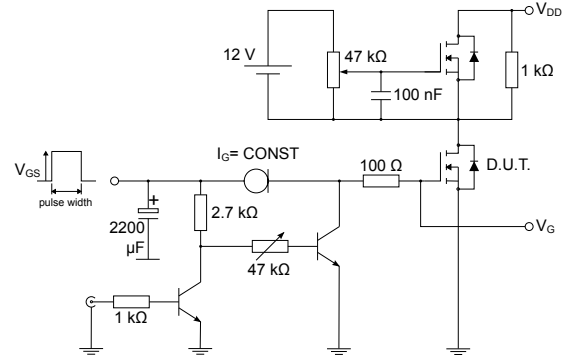
**Figure 11. Normalized V\_(BR)DSS vs temperature**



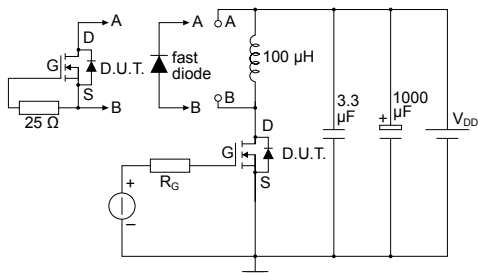
### 3 Test circuits

**Figure 12. Test circuit for resistive load switching times**


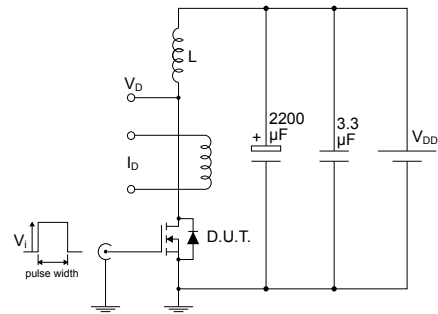
AM01468v1

**Figure 13. Test circuit for gate charge behavior**


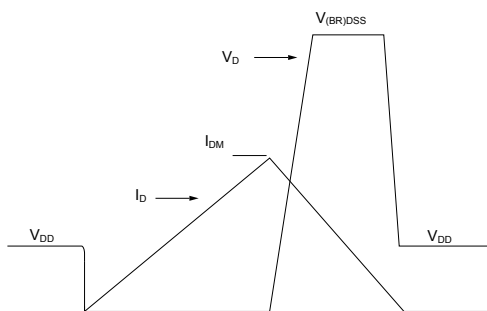
AM01469v1

**Figure 14. Test circuit for inductive load switching and diode recovery times**


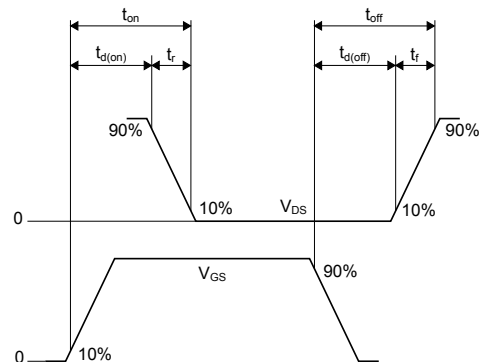
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**Figure 15. Unclamped inductive load test circuit**


AM01471v1

**Figure 16. Unclamped inductive waveform**


AM01472v1

**Figure 17. Switching time waveform**


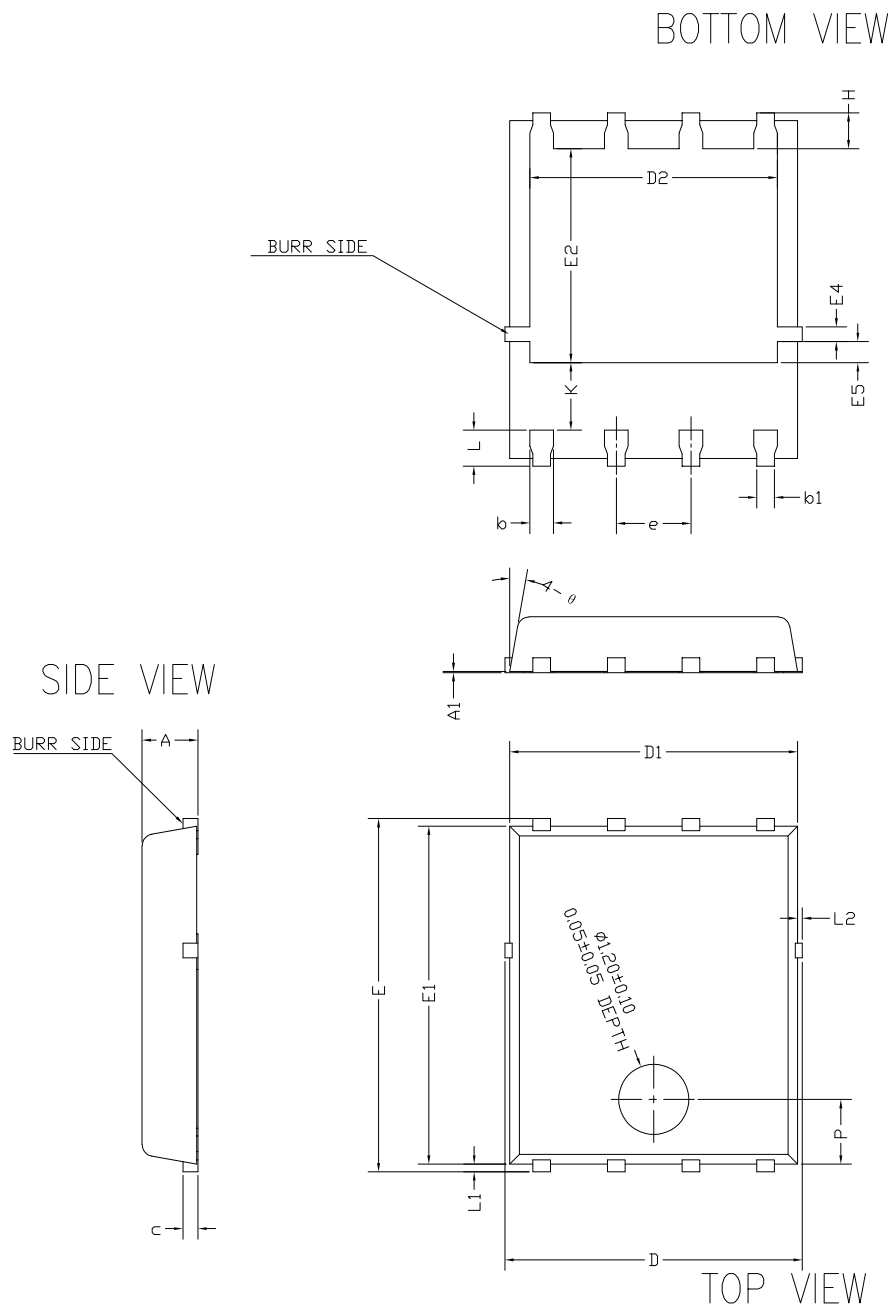
AM01473v1

## 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 5x6 type B package information

**Figure 18. PowerFLAT 5x6 type B package outline**



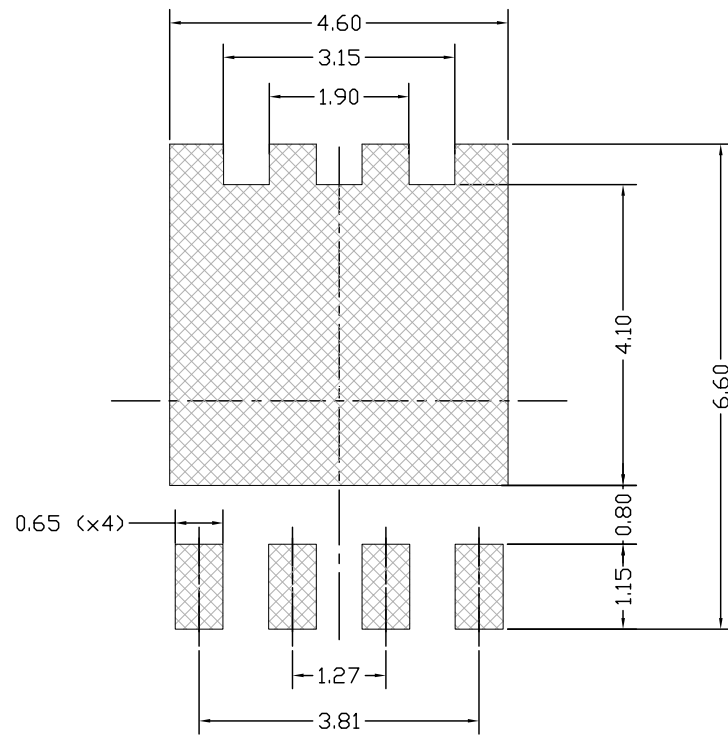
Drawing\_8472137\_typeB rev5

**Table 7. PowerFLAT 5x6 type B mechanical data**

| Dim.     | mm   |      |      |
|----------|------|------|------|
|          | Min. | Typ. | Max. |
| A        | 0.90 | 0.95 | 1.00 |
| A1       |      | 0.02 |      |
| b        | 0.35 | 0.40 | 0.45 |
| b1       |      | 0.30 |      |
| c        | 0.21 | 0.25 | 0.34 |
| D        | 4.80 |      | 5.10 |
| D1       | 4.80 | 4.90 | 5.00 |
| D2       | 4.01 | 4.21 | 4.31 |
| e        | 1.17 | 1.27 | 1.37 |
| E        | 5.90 | 6.00 | 6.10 |
| E1       | 5.70 | 5.75 | 5.80 |
| E2       | 3.54 | 3.64 | 3.74 |
| E4       | 0.15 | 0.25 | 0.35 |
| E5       | 0.26 | 0.36 | 0.46 |
| H        | 0.51 | 0.61 | 0.71 |
| K        | 0.95 |      |      |
| L        | 0.51 | 0.61 | 0.71 |
| L1       | 0.06 | 0.13 | 0.20 |
| L2       |      |      | 0.10 |
| P        | 1.00 | 1.10 | 1.20 |
| $\theta$ | 8°   | 10°  | 12°  |



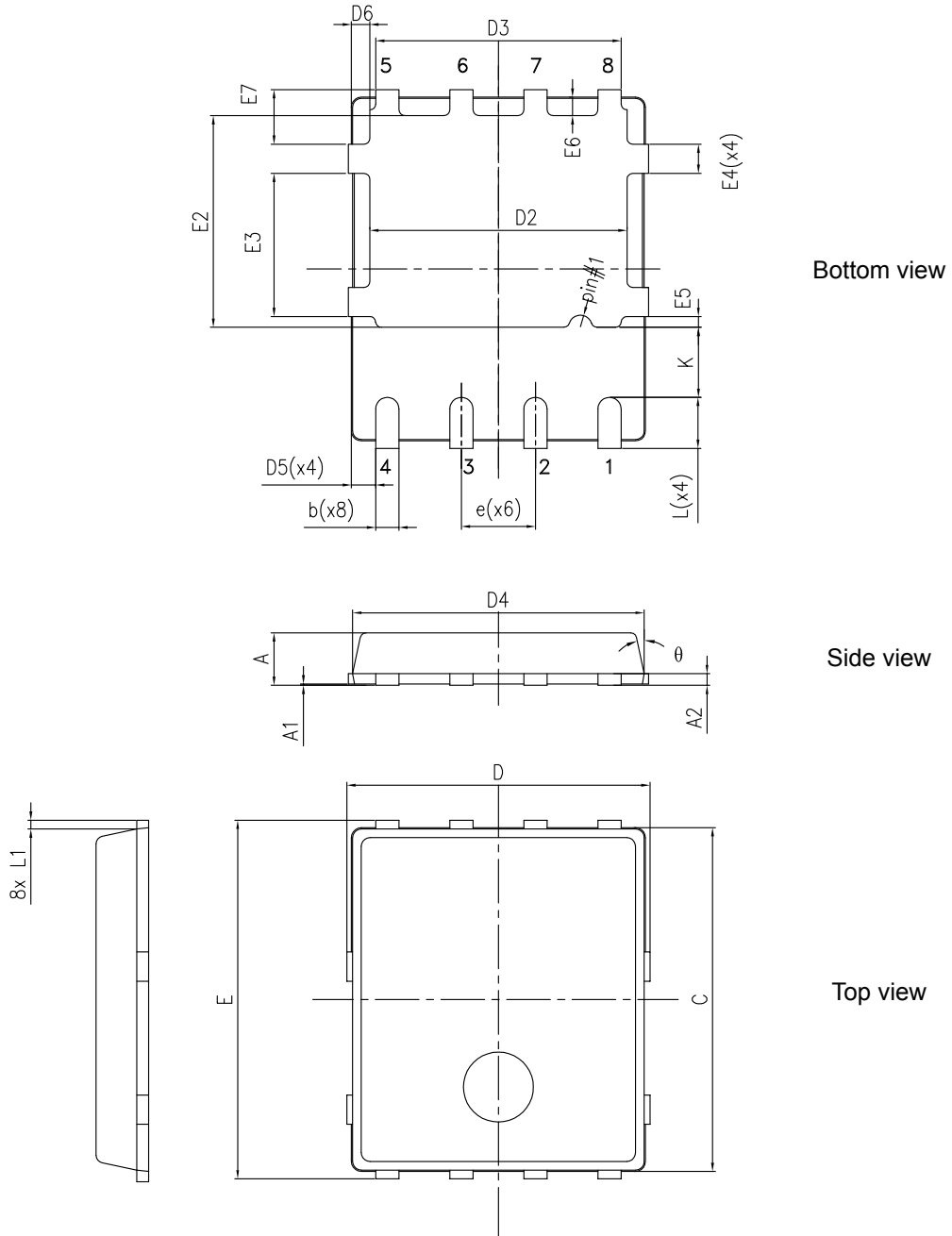
Figure 19. PowerFLAT 5x6 recommended footprint (dimensions are in mm)



Footprint\_8472137\_typeB rev5

## 4.2 PowerFLAT 5x6 type C package information

Figure 20. PowerFLAT 5x6 type C package outline

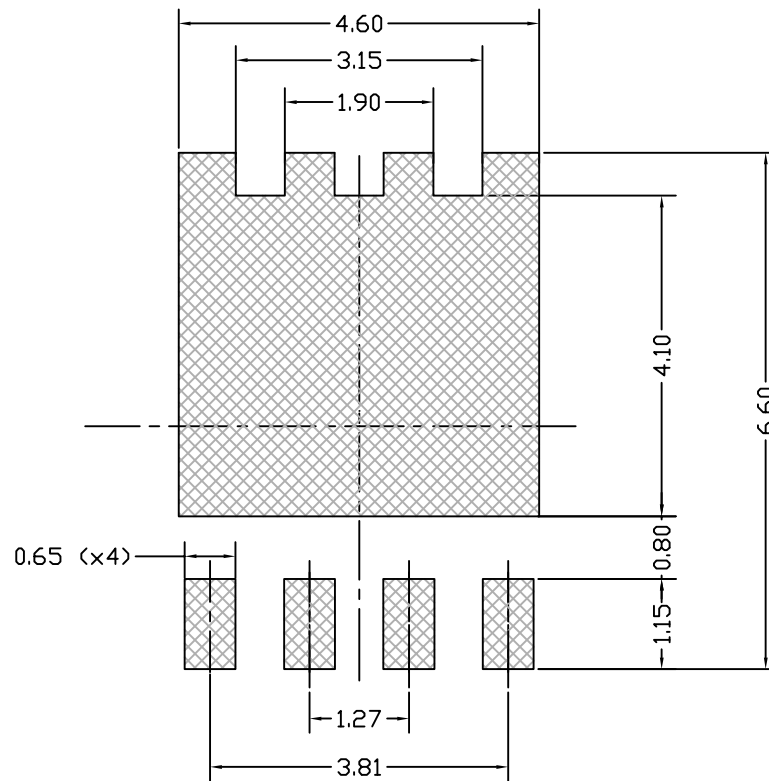


8231817\_typeC\_Rev23

**Table 8. PowerFLAT 5x6 type C package mechanical data**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 0.80  |       | 1.00  |
| A1   |       |       | 0.05  |
| A2   |       | 0.25  |       |
| b    | 0.30  |       | 0.50  |
| C    | 5.80  | 6.00  | 6.20  |
| D    | 5.00  | 5.20  | 5.40  |
| D2   | 4.15  |       | 4.45  |
| D3   | 4.05  | 4.20  | 4.35  |
| D4   | 4.80  | 5.00  | 5.20  |
| D5   | 0.25  | 0.40  | 0.55  |
| D6   | 0.15  | 0.30  | 0.45  |
| e    |       | 1.27  |       |
| E    | 5.95  | 6.15  | 6.35  |
| E2   | 3.50  |       | 3.70  |
| E3   | 2.35  |       | 2.55  |
| E4   | 0.40  |       | 0.60  |
| E5   | 0.08  |       | 0.28  |
| E6   | 0.20  | 0.325 | 0.45  |
| E7   | 0.75  | 0.90  | 1.05  |
| K    | 1.05  |       | 1.35  |
| L    | 0.725 |       | 1.025 |
| L1   | 0.05  | 0.15  | 0.25  |
| θ    | 0°    |       | 12°   |

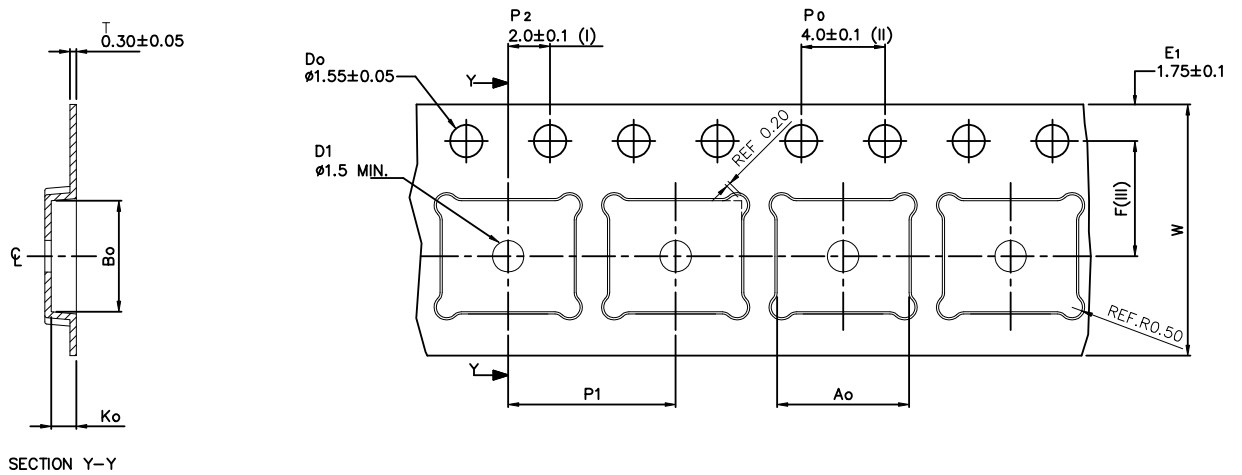
Figure 21. PowerFLAT 5x6 recommended footprint (dimensions are in mm)



8231817\_FOOTPRINT\_simp\_Rev\_23

### 4.3 PowerFLAT 5x6 packing information

Figure 22. PowerFLAT 5x6 tape (dimensions are in mm)



|                |       |     |     |
|----------------|-------|-----|-----|
| A <sub>o</sub> | 6.30  | +/- | 0.1 |
| B <sub>o</sub> | 5.30  | +/- | 0.1 |
| K <sub>o</sub> | 1.20  | +/- | 0.1 |
| F              | 5.50  | +/- | 0.1 |
| P <sub>1</sub> | 8.00  | +/- | 0.1 |
| W              | 12.00 | +/- | 0.3 |

(I) Measured from centreline of sprocket hole to centreline of pocket.

(II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .

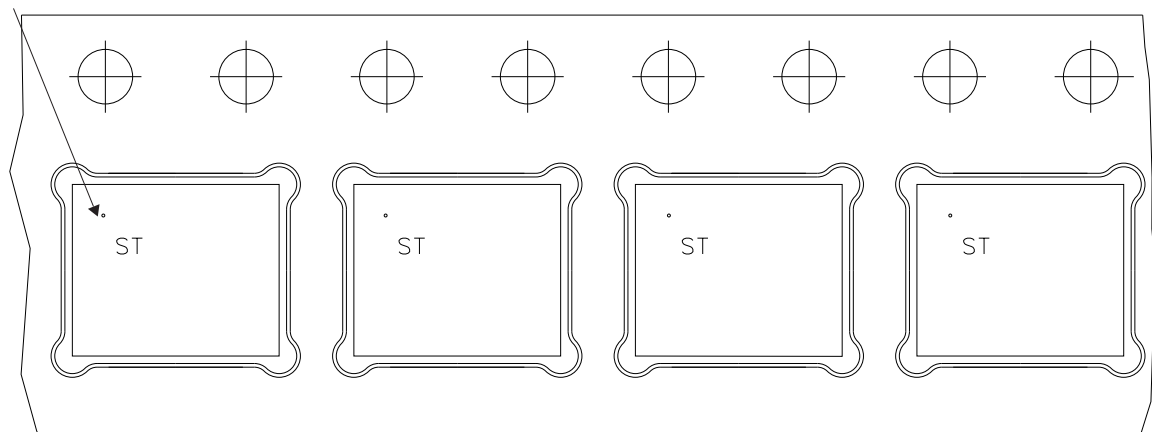
(III) Measured from centreline of sprocket hole to centreline of pocket

Base and bulk quantity 3000 pcs  
All dimensions are in millimeters

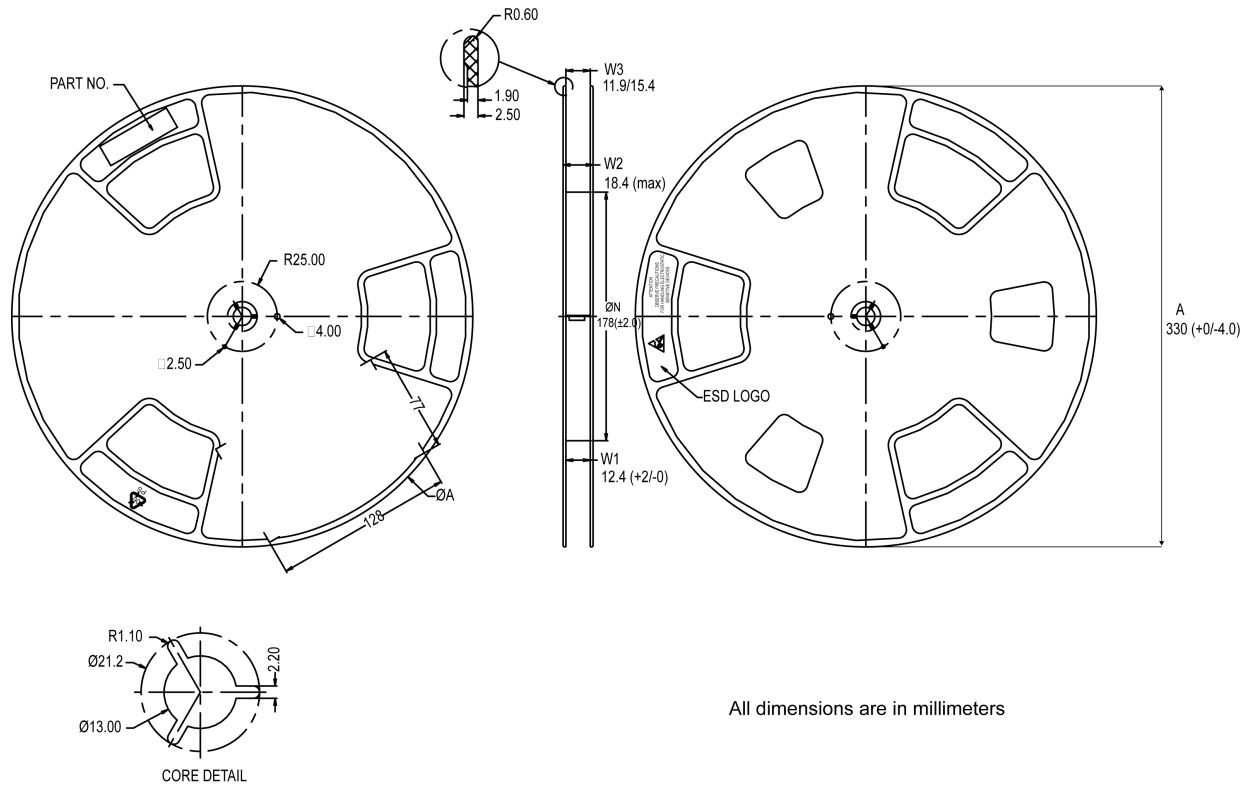
8234350\_Tape\_rev\_C

Figure 23. PowerFLAT 5x6 package orientation in carrier tape

Pin 1 identification



**Figure 24. PowerFLAT 5x6 reel**



All dimensions are in millimeters

8234350\_Reel\_rev\_C

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 13-Jun-2014 | 1        | First release.  |
| 22-Sep-2014 | 2        | Updated title, features and description in cover page.<br>Updated <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "On /off states"</i> , <i>Table 5: "Dynamic"</i> , <i>Table 6: "Switching times"</i> and <i>Table 7: "Source-drain diode"</i> .<br>Added <i>Section 3: "Electrical characteristics (curves)"</i> .           |
| 14-Jan-2015 | 3        | Document status promoted from preliminary to production data.   |
| 02-May-2017 | 4        | Modified title and features table on cover page.<br>Modified <i>Table 1. Absolute maximum ratings</i> , <i>Table 3. On /off states</i> , <i>Table 4. Dynamic</i> , <i>Table 5. Switching times</i> and <i>Table 6. Source-drain diode</i> .<br>Modified <i>Section 2.1 Electrical characteristics (curves)</i> .<br>Minor text changes. |
| 20-Sep-2022 | 5        | Inserted <i>Section 4.1 PowerFLAT 5x6 type B package information</i> .<br>Minor text changes.   |
| 15-Mar-2023 | 6        | Updated <a href="#">Section 4.2 PowerFLAT 5x6 type C package information</a> .  |

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