

## N-channel 60 V, 0.0046 $\Omega$ typ., 20 A STripFET™ F7 Power MOSFET in a PowerFLAT™ 3.3x3.3 package

Datasheet - production data

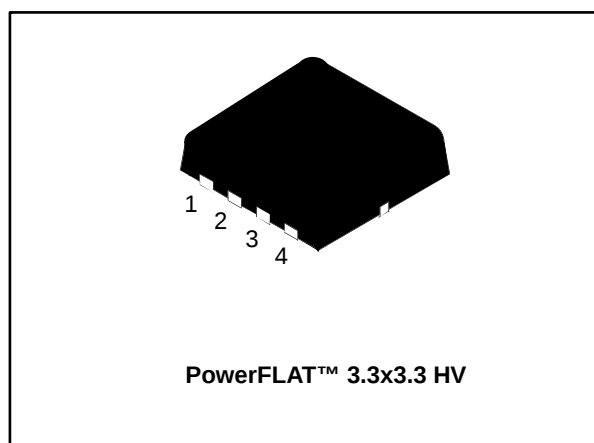


Figure 1: Internal schematic diagram

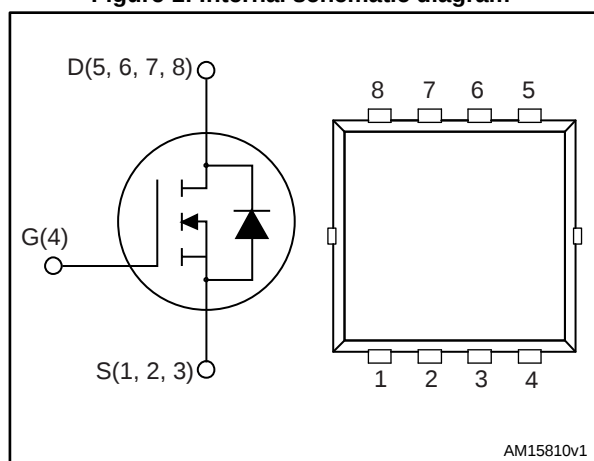


Table 1: Device summary

| Order code | Marking | Package            | Packing       |
|------------|---------|--------------------|---------------|
| STL20N6F7  | 20N6F   | PowerFLAT™ 3.3x3.3 | Tape and reel |

### Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|------------|-----------------|-------------------------|----------------|
| STL20N6F7  | 60 V            | 0.0054 $\Omega$         | 20 A           |

- Among the lowest R<sub>DS(on)</sub> on the market
- Excellent figure of merit (FoM)
- 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.

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## Contents

|          |                                                 |           |
|----------|-------------------------------------------------|-----------|
| <b>1</b> | <b>Electrical ratings .....</b>                 | <b>3</b>  |
| <b>2</b> | <b>Electrical characteristics .....</b>         | <b>4</b>  |
|          | 2.1 Electrical characteristics.....             | 5         |
| <b>3</b> | <b>Test circuits .....</b>                      | <b>7</b>  |
| <b>4</b> | <b>Package mechanical data .....</b>            | <b>8</b>  |
|          | 4.1 PowerFLAT 3.3x3.3 package information ..... | 9         |
| <b>5</b> | <b>Revision history .....</b>                   | <b>12</b> |

# 1 Electrical ratings

Table 2: 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 $T_C = 25\text{ }^\circ\text{C}$      | 100        | A                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$     | 61         | A                |
| $I_{DM}^{(1)(2)}$ | Drain current (pulsed)                                              | 400        | A                |
| $I_D^{(3)}$       | Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$  | 20         | A                |
| $I_D^{(3)}$       | Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$ | 12         | A                |
| $I_{DM}^{(2)(3)}$ | Drain current (pulsed)                                              | 80         | A                |
| $P_{TOT}^{(1)}$   | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$               | 78         | W                |
| $P_{TOT}^{(3)}$   | Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$           | 3          | W                |
| $T_{stg}$         | Storage temperature                                                 | -55 to 150 | $^\circ\text{C}$ |
| $T_j$             | Operating junction temperature                                      |            |                  |

**Notes:**

<sup>(1)</sup>This value is rated according to  $R_{thj-c}$ .

<sup>(2)</sup>Pulse width limited by safe operating area.

<sup>(3)</sup>This value is rated according to  $R_{thj-pcb}$ .

Table 3: Thermal data

| Symbol              | Parameter                             | Value | Unit               |
|---------------------|---------------------------------------|-------|--------------------|
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max.  | 42.8  | $^\circ\text{C/W}$ |
| $R_{thj-case}$      | Thermal resistance junction-case max. | 1.6   | $^\circ\text{C/W}$ |

**Notes:**

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

## 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    | $I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$        | 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         | $V_{GS} = 20\text{ V}$ , $V_{DS} = 0$              |      |        | 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 | $V_{GS} = 10\text{ V}$ , $I_D = 10\text{ A}$       |      | 0.0046 | 0.0054 | $\Omega$      |

**Table 5: Dynamic**

| Symbol    | Parameter                    | Test conditions                                                          | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--------------------------------------------------------------------------|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0\text{ V}$   | -    | 1600 | -    | pF   |
| $C_{oss}$ | Output capacitance           |                                                                          | -    | 880  | -    | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                                                          | -    | 66   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 30\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ | -    | 25   | -    | nC   |
| $Q_{gs}$  | Gate-source charge           |                                                                          | -    | 7.2  | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                                                          | -    | 8.1  | -    | nC   |

**Table 6: Switching times**

| Symbol       | Parameter           | Test conditions                                                                                      | Min. | Typ. | Max. | Unit |
|--------------|---------------------|------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 30\text{ V}$ , $I_D = 10\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ | -    | 15   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                      | -    | 17.6 | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                      | -    | 24.4 | -    | ns   |
| $t_f$        | Fall time           |                                                                                                      | -    | 7.8  | -    | ns   |

**Table 7: Source-drain diode**

| Symbol         | Parameter                | Test conditions                                                                       | Min. | Typ. | Max. | Unit |
|----------------|--------------------------|---------------------------------------------------------------------------------------|------|------|------|------|
| $V_{SD}^{(1)}$ | Forward on voltage       | $I_{SD} = 20\text{ A}$ , $V_{GS} = 0$                                                 | -    |      | 1.2  | V    |
| $t_{rr}$       | Reverse recovery time    | $I_D = 20\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 48\text{ V}$ | -    | 39.6 |      | ns   |
| $Q_{rr}$       | Reverse recovery charge  |                                                                                       | -    | 36   |      | nC   |
| $I_{RRM}$      | Reverse recovery current |                                                                                       | -    | 1.8  |      | A    |

**Notes:**

<sup>(1)</sup> Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics

Figure 2: Safe operating area

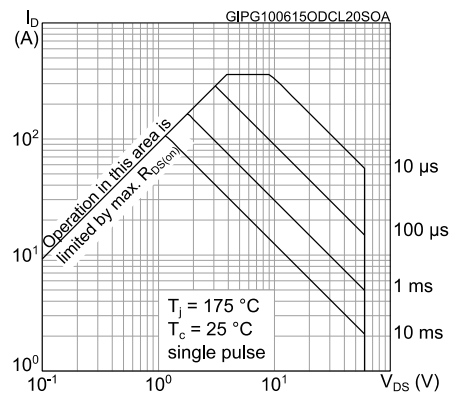


Figure 3: Thermal impedance

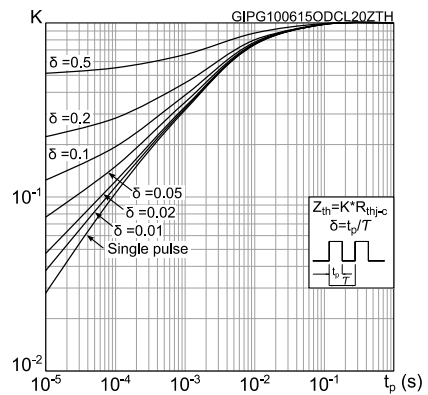


Figure 4: Output characteristics

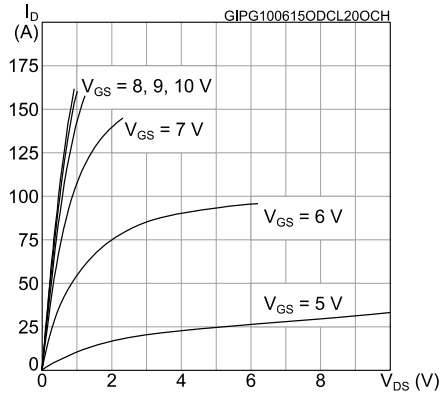


Figure 5: Transfer characteristics

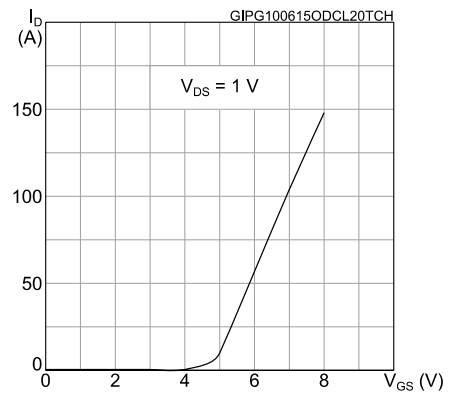


Figure 6: Gate charge vs gate-source voltage

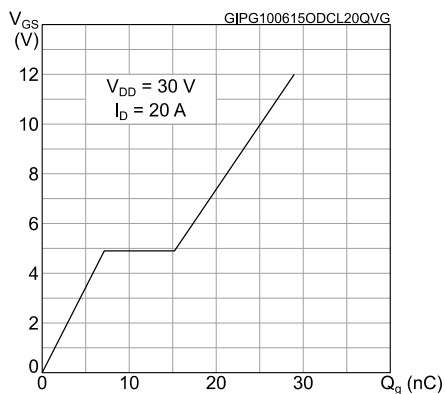


Figure 7: Static drain-source on-resistance

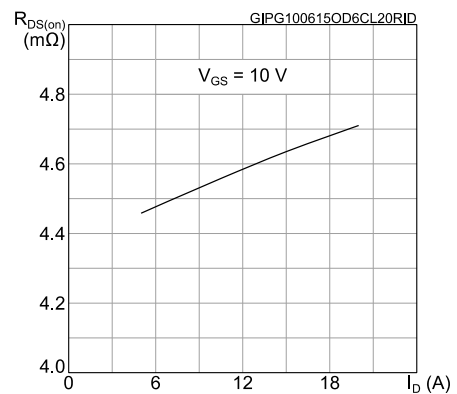


Figure 8: Capacitance variations

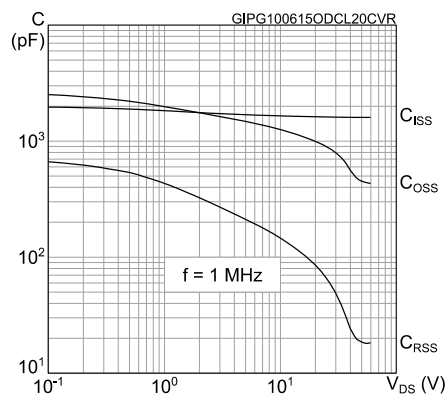


Figure 9: Normalized gate threshold voltage vs temperature

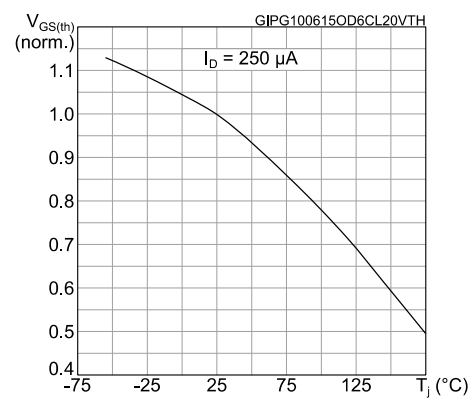


Figure 10: Normalized on-resistance vs temperature

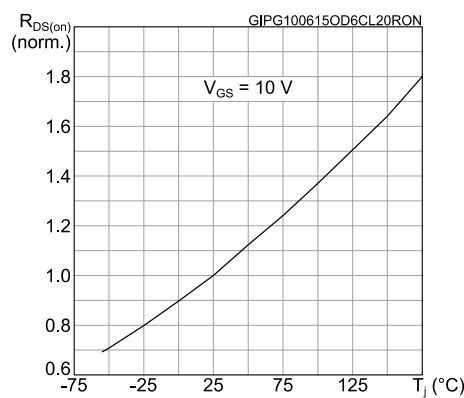


Figure 11: Normalized V(BR)DSS vs temperature

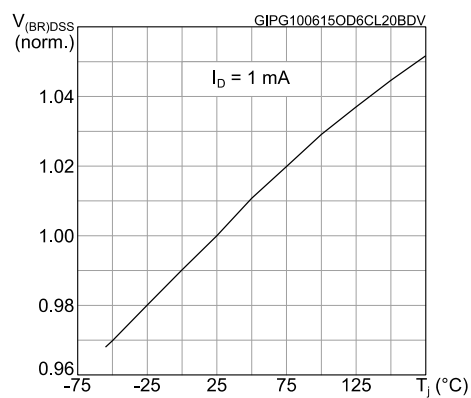
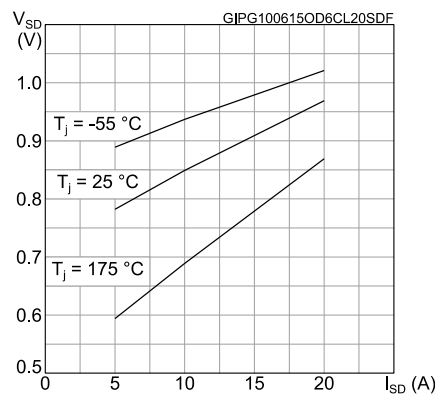
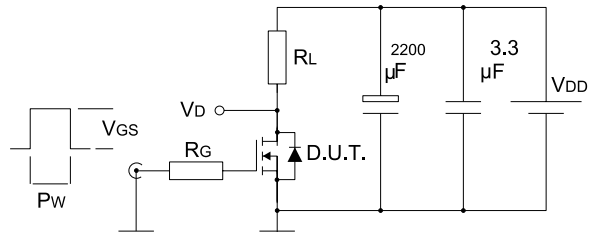


Figure 12: Source-drain diode forward characteristics



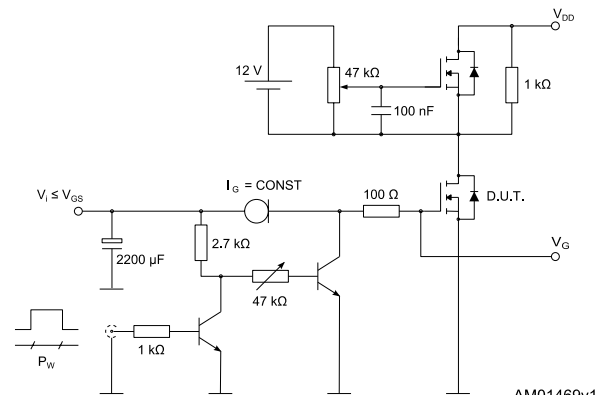
### 3 Test circuits

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



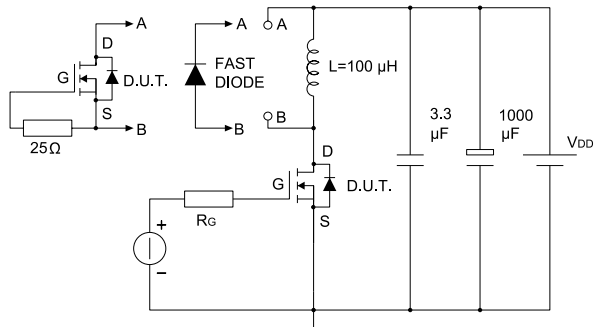
AM01468v1

**Figure 14: Gate charge test circuit**



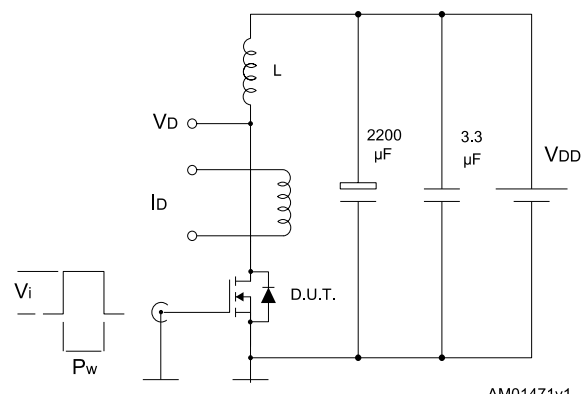
AM01469v1

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



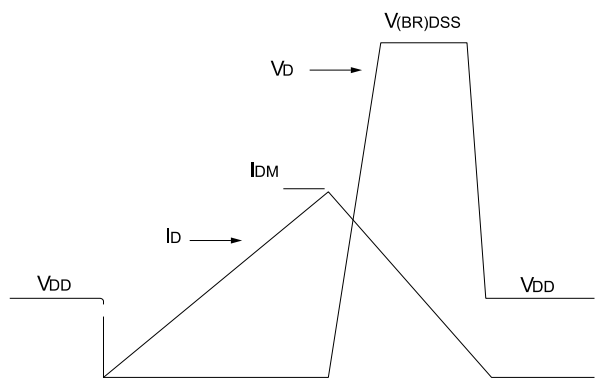
AM01470v1

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



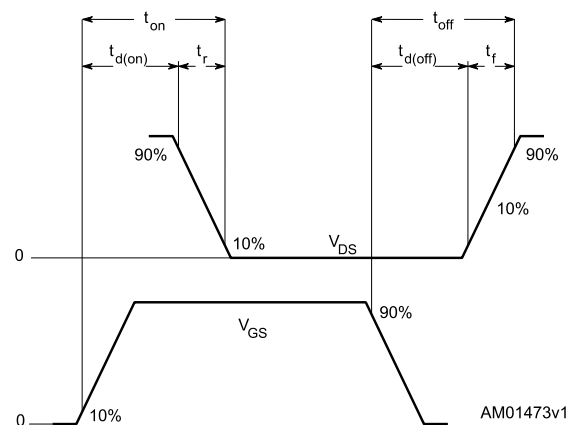
AM01471v1

**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: Switching time waveform**



AM01473v1

## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: **[www.st.com](http://www.st.com)**. ECOPACK<sup>®</sup> is an ST trademark.

## 4.1 PowerFLAT 3.3x3.3 package information

Figure 19: PowerFLAT™ 3.3x3.3 HV package outline

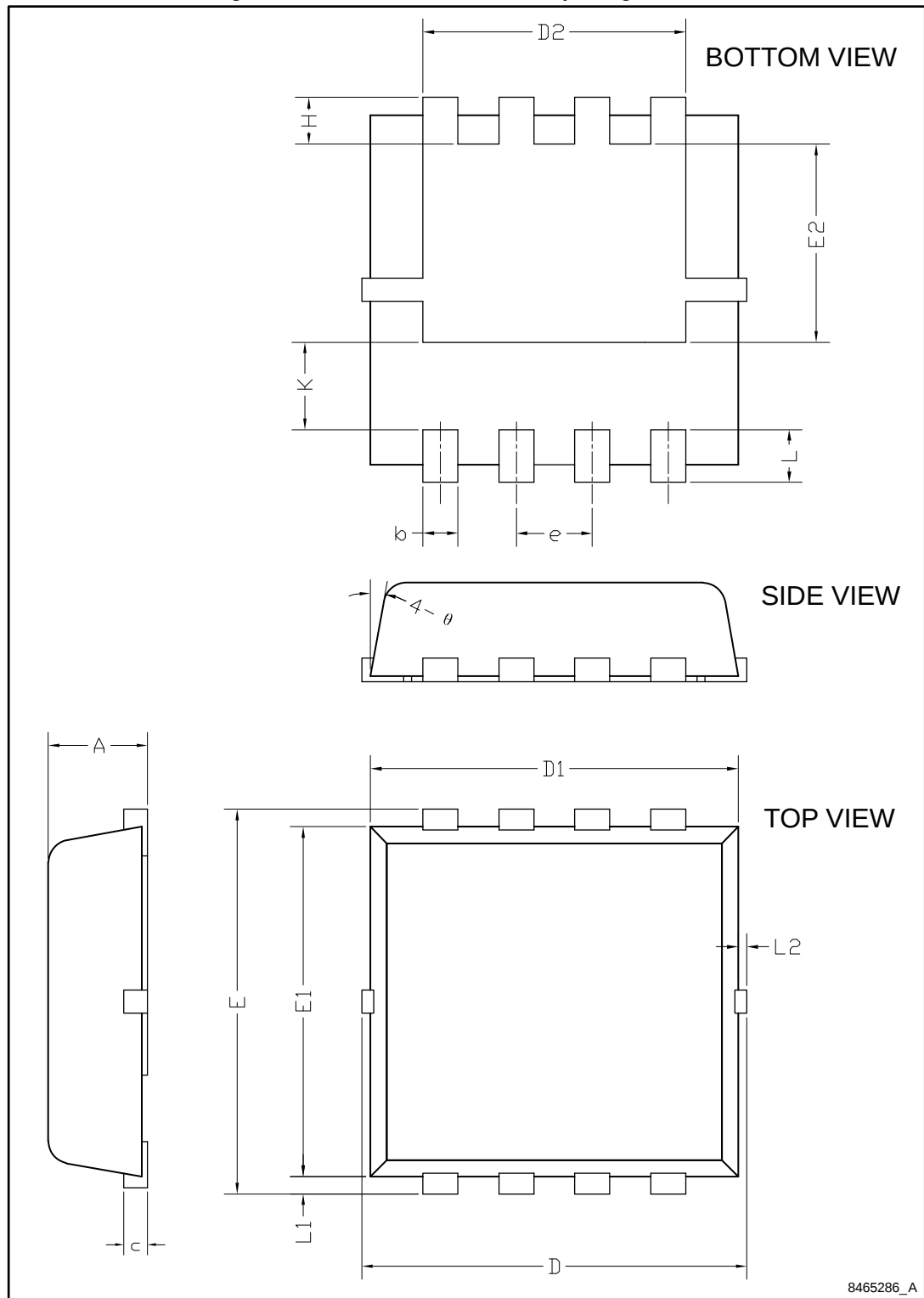
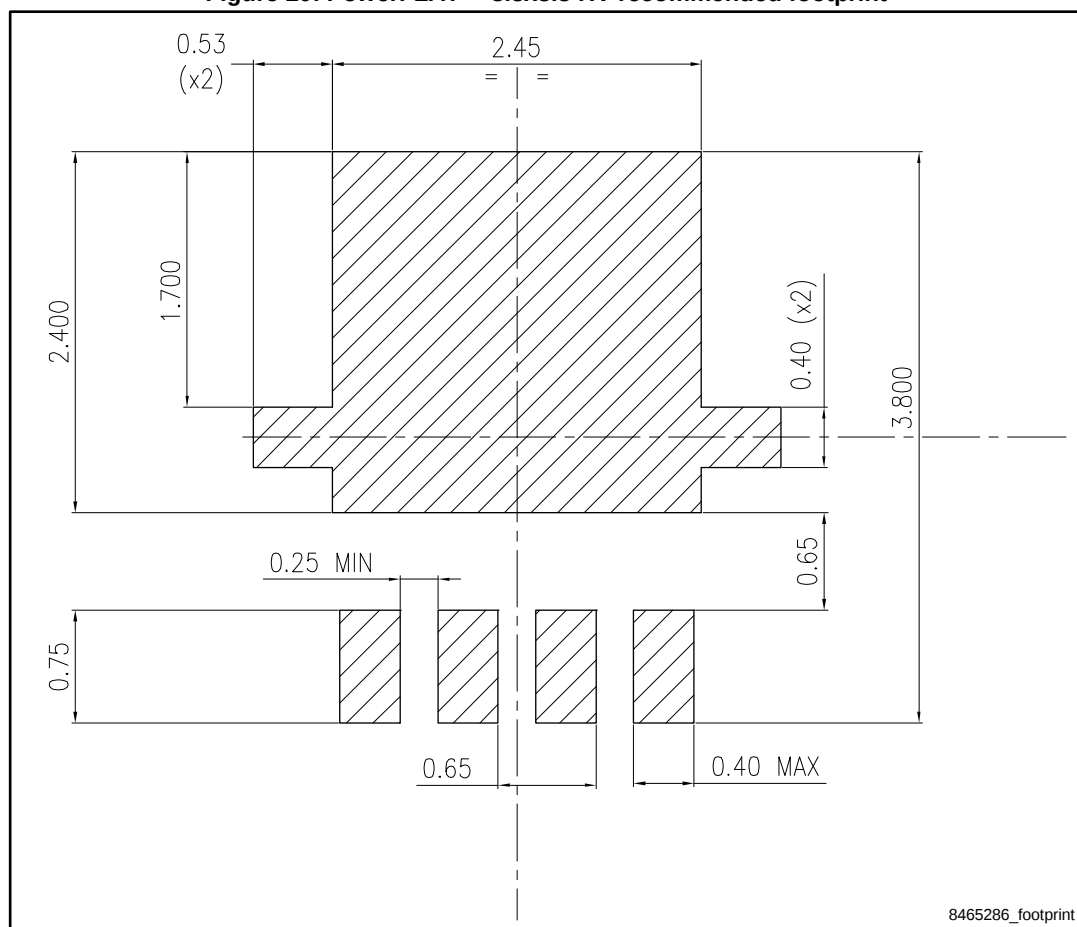


Table 8: PowerFLAT™ 3.3x3.3 HV package mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 0.70 | 0.80 | 0.90 |
| b    | 0.25 | 0.30 | 0.39 |
| c    | 0.14 | 0.15 | 0.20 |
| D    | 3.10 | 3.30 | 3.50 |
| D1   | 3.05 | 3.15 | 3.25 |
| D2   | 2.15 | 2.25 | 2.35 |
| e    | 0.55 | 0.65 | 0.75 |
| E    | 3.10 | 3.30 | 3.50 |
| E1   | 2.90 | 3.00 | 3.10 |
| E2   | 1.60 | 1.70 | 1.80 |
| H    | 0.25 | 0.40 | 0.55 |
| K    | 0.65 | 0.75 | 0.85 |
| L    | 0.30 | 0.45 | 0.60 |
| L1   | 0.05 | 0.15 | 0.25 |
| L2   |      |      | 0.5  |
| θ    | 8°   | 10°  | 12°  |

**Figure 20: PowerFLAT™ 3.3x3.3 HV recommended footprint**



## 5 Revision history

**Table 9: Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                        |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28-Jan-2015 | 1        | First release.                                                                                                                                                                                                 |
| 03-Feb-2015 | 2        | Updated <a href="#">Table 2: "Absolute maximum ratings"</a>                                                                                                                                                    |
| 10-Jun-2015 | 3        | In Section 2 Electrical characteristics:<br>- updated Table 5: Dynamic<br>- updated Table 6: Switching times<br>- updated Table 7: Source-drain diode<br>Added Section 2.1 Electrical characteristics (curves) |

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