



# PXP020-20QX

20 V, P-channel Trench MOSFET

31 July 2023

Product data sheet

## 1. General description

P-channel enhancement mode Field-Effect Transistor (FET) in an MLPAK33 (SOT8002) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

## 2. Features and benefits

- Low threshold voltage
- Trench MOSFET technology
- MLPAK33 package (3.3 x 3.3 mm footprint)

## 3. Applications

- High-side load switch
- Battery management
- DC-to-DC conversion
- Switching circuits

## 4. Quick reference data

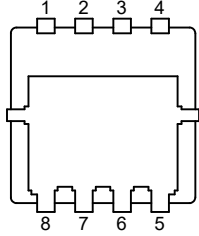
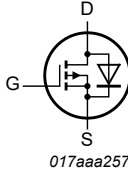
Table 1. Quick reference data

| Symbol                        | Parameter                        | Conditions  | Min | Typ  | Max   | Unit |
|-------------------------------|----------------------------------|---|-----|------|-------|------|
| $V_{DS}$                      | drain-source voltage             | $T_j = 25\text{ °C}$  | -   | -    | -20   | V    |
| $V_{GS}$                      | gate-source voltage              |   | -12 | -    | 12    | V    |
| $I_D$                         | drain current                    | $V_{GS} = -4.5\text{ V}; T_{amb} = 25\text{ °C}; t \leq 5\text{ s}$ | [1] | -    | -12.1 | A    |
| <b>Static characteristics</b> |                                  |   |     |      |       |      |
| $R_{DSon}$                    | drain-source on-state resistance | $V_{GS} = -4.5\text{ V}; I_D = -7.7\text{ A}; T_j = 25\text{ °C}$   | -   | 16   | 20    | mΩ   |
|                               |                                  | $V_{GS} = -2.5\text{ V}; I_D = -5.8\text{ A}; T_j = 25\text{ °C}$   | -   | 26.4 | 35.2  | mΩ   |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 6 cm<sup>2</sup>.

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline   | Graphic symbol   |
|-----|--------|-------------|--|--|
| 1   | S      | source      |  <p>MLPAK33 (SOT8002-1)</p> |  <p>017aaa257</p> |
| 2   | S      | source      |  |  |
| 3   | S      | source      |  |  |
| 4   | G      | gate        |  |  |
| 5   | D      | drain       |  |  |
| 6   | D      | drain       |  |  |
| 7   | D      | drain       |  |  |
| 8   | D      | drain       |  |  |

## 6. Ordering information

Table 3. Ordering information

| Type number | Package |   |           |
|-------------|---------|---|-----------|
|             | Name    | Description   | Version   |
| PXP020-20QX | MLPAK33 | plastic thermal enhanced surface mounted package; mini leads; 8 terminals; pitch 0.65 mm; 3.3 x 3.3 x 0.8 mm body | SOT8002-1 |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PXP020-20QX | 8AD          |

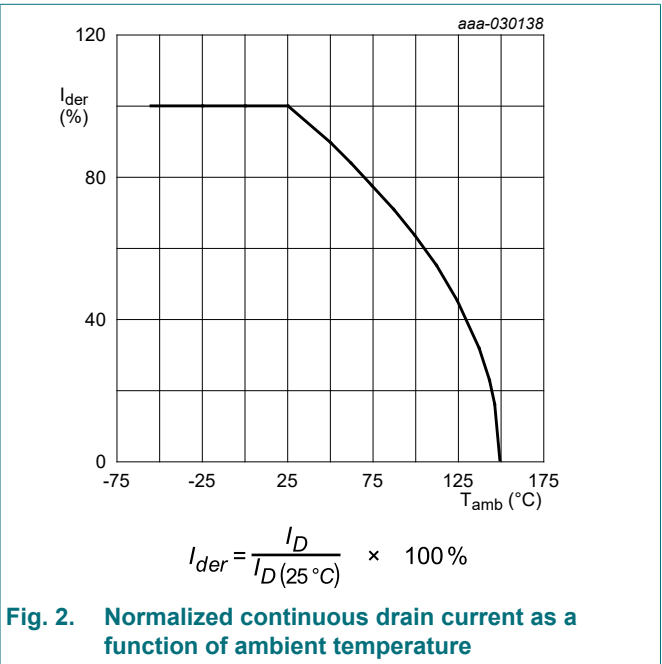
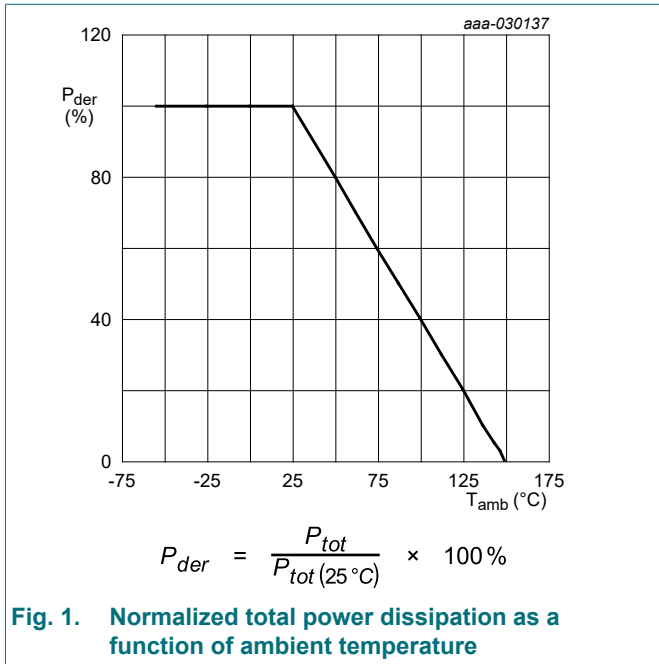
## 8. Limiting values

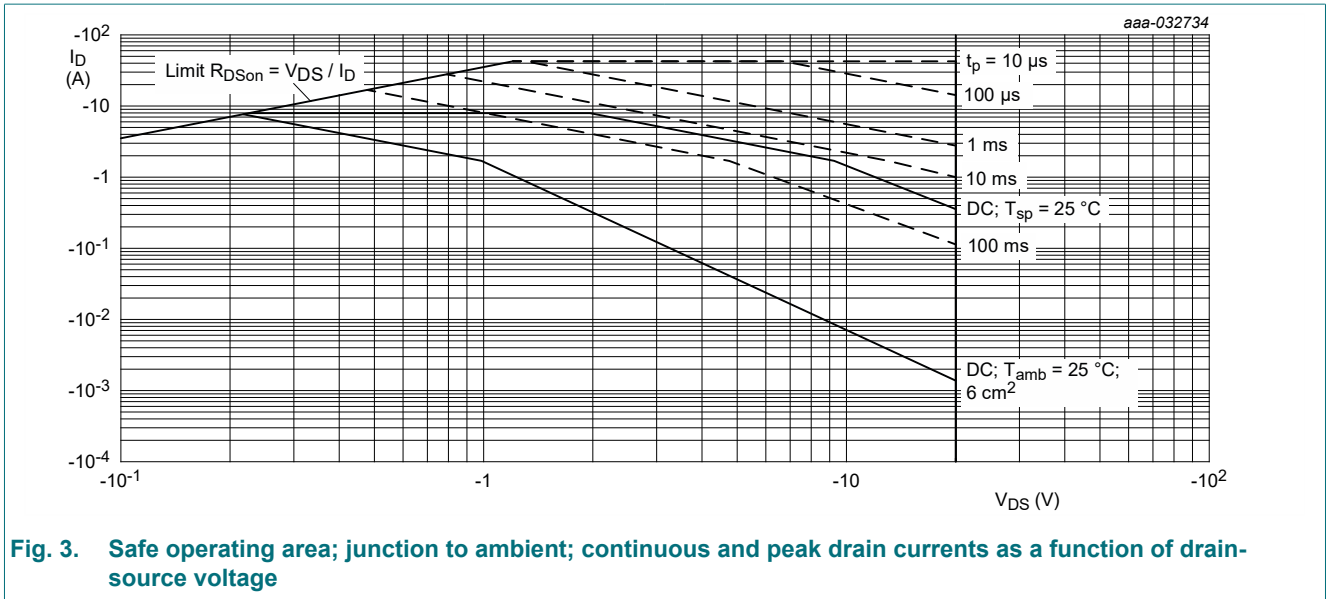
**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol                    | Parameter               | Conditions   | Min | Max   | Unit  |   |
|---------------------------|-------------------------|--|-----|-------|-------|---|
| V <sub>DS</sub>           | drain-source voltage    | T <sub>j</sub> = 25 °C   | -   | -20   | V     |   |
| V <sub>GS</sub>           | gate-source voltage     |  | -12 | 12    | V     |   |
| I <sub>D</sub>            | drain current           | V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 25 °C; t ≤ 5 s    | [1] | -     | -12.1 | A |
|                           |                         | V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 25 °C             | [1] | -     | -8    | A |
|                           |                         | V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 100 °C            | [1] | -     | -4.8  | A |
|                           |                         | V <sub>GS</sub> = -4.5 V; T <sub>sp</sub> = 25 °C              |     | -     | -23.5 | A |
| I <sub>DM</sub>           | peak drain current      | T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs | -   | -42.4 | A     |   |
| P <sub>tot</sub>          | total power dissipation | T <sub>amb</sub> = 25 °C; t ≤ 5 s                              | [1] | -     | 4.2   | W |
|                           |                         | T <sub>amb</sub> = 25 °C                                       | [1] | -     | 1.7   | W |
|                           |                         | T <sub>sp</sub> = 25 °C  |     | -     | 15    | W |
| T <sub>j</sub>            | junction temperature    |  | -55 | 150   | °C    |   |
| T <sub>amb</sub>          | ambient temperature     |  | -55 | 150   | °C    |   |
| T <sub>stg</sub>          | storage temperature     |  | -65 | 150   | °C    |   |
| <b>Source-drain diode</b> |                         |  |     |       |       |   |
| I <sub>S</sub>            | source current          | T <sub>amb</sub> = 25 °C                                       | [1] | -     | -1.7  | A |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 6 cm<sup>2</sup>.





## 9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter  | Conditions                |     | Min | Typ | Max | Unit |
|----------------|--|---------------------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air               | [1] | -   | 150 | 190 | K/W  |
|                |  |                           | [2] | -   | 60  | 75  | K/W  |
|                |  | in free air; $t \leq 5$ s | [2] | -   | 25  | 30  | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |                           |     | -   | 4   | 8   | K/W  |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm<sup>2</sup>.

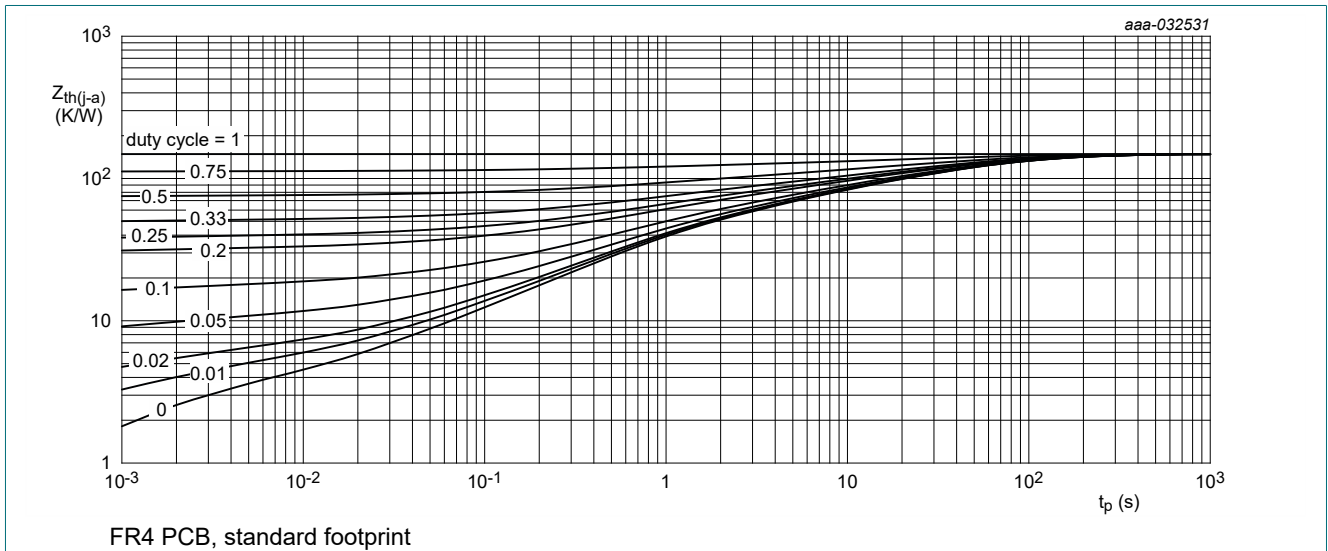


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

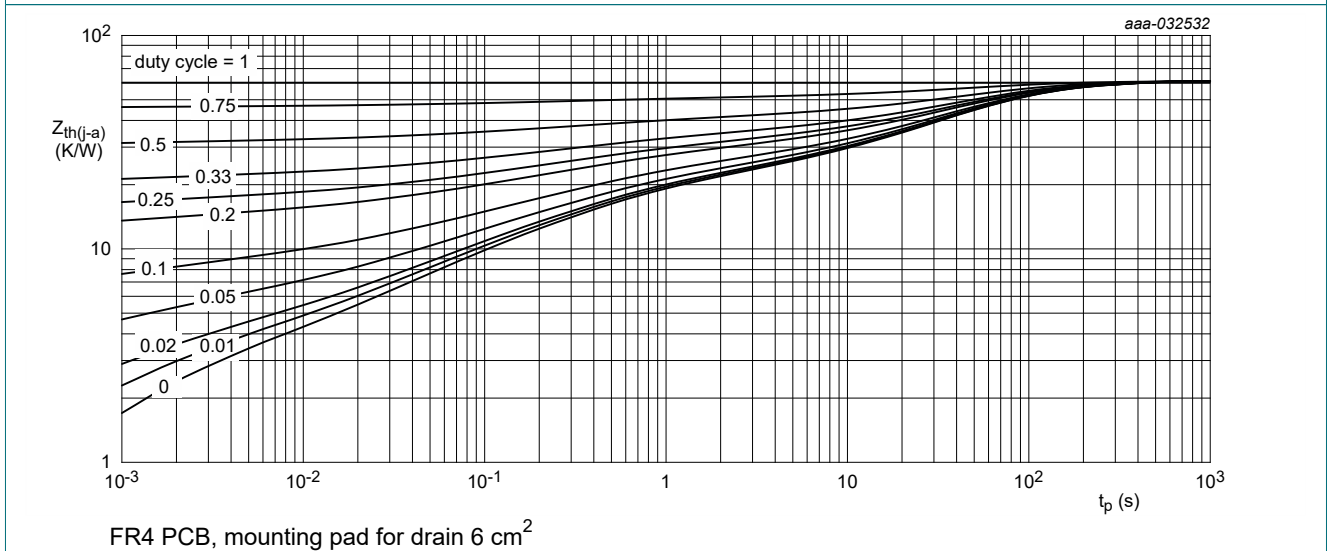


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

| Symbol                         | Parameter                         | Conditions  | Min  | Typ  | Max   | Unit          |
|--------------------------------|-----------------------------------|---|------|------|-------|---------------|
| <b>Static characteristics</b>  |                                   |   |      |      |       |               |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage    | $I_D = -250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$   | -20  | -    | -     | V             |
| $V_{GSth}$                     | gate-source threshold voltage     | $I_D = -250 \mu\text{A}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ\text{C}$  | -0.7 | -0.9 | -1.25 | V             |
| $I_{DSS}$                      | drain leakage current             | $V_{DS} = -20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$   | -    | -    | -1    | $\mu\text{A}$ |
| $I_{GSS}$                      | gate leakage current              | $V_{GS} = -12 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$   | -    | -    | -100  | nA            |
|                                |                                   | $V_{GS} = 12 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$  | -    | -    | 100   | nA            |
| $R_{DSon}$                     | drain-source on-state resistance  | $V_{GS} = -4.5 \text{ V}; I_D = -7.7 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$  | -    | 16   | 20    | m $\Omega$    |
|                                |                                   | $V_{GS} = -4.5 \text{ V}; I_D = -7.7 \text{ A}; T_j = 150 \text{ }^\circ\text{C}$   | -    | 22.7 | 28.4  | m $\Omega$    |
|                                |                                   | $V_{GS} = -2.5 \text{ V}; I_D = -5.8 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$  | -    | 26.4 | 35.2  | m $\Omega$    |
| $g_{fs}$                       | forward transconductance          | $V_{DS} = -10 \text{ V}; I_D = -7.7 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$   | -    | 21.4 | -     | S             |
| $R_G$                          | gate resistance                   | $f = 1 \text{ MHz}$   | -    | 6.4  | -     | $\Omega$      |
| <b>Dynamic characteristics</b> |                                   |   |      |      |       |               |
| $Q_{G(tot)}$                   | total gate charge                 | $V_{DS} = -10 \text{ V}; I_D = -7.7 \text{ A}; V_{GS} = -4.5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$                                      | -    | 19.4 | 29.1  | nC            |
| $Q_{GS}$                       | gate-source charge                |   | -    | 3.4  | -     | nC            |
| $Q_{GS(th)}$                   | pre-threshold gate-source charge  |   | -    | 1.6  | -     | nC            |
| $Q_{GS(th-pl)}$                | post-threshold gate-source charge |   | -    | 1.8  | -     | nC            |
| $Q_{GD}$                       | gate-drain charge                 |   | -    | 6.2  | -     | nC            |
| $V_{GSpl}$                     | gate-source plateau voltage       | $V_{DS} = -10 \text{ V}; I_D = -7.7 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$   | -    | -1.8 | -     | V             |
| $C_{iss}$                      | input capacitance                 | $V_{DS} = -10 \text{ V}; f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$  | -    | 1900 | -     | pF            |
| $C_{oss}$                      | output capacitance                |   | -    | 275  | -     | pF            |
| $C_{rss}$                      | reverse transfer capacitance      |   | -    | 250  | -     | pF            |
| $t_{d(on)}$                    | turn-on delay time                | $V_{DS} = -10 \text{ V}; I_D = -5.8 \text{ A}; V_{GS} = -4.5 \text{ V}; R_{G(ext)} = 5 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$      | -    | 6    | -     | ns            |
| $t_r$                          | rise time                         |   | -    | 23   | -     | ns            |
| $t_{d(off)}$                   | turn-off delay time               |   | -    | 46   | -     | ns            |
| $t_f$                          | fall time                         |   | -    | 31   | -     | ns            |
| <b>Source-drain diode</b>      |                                   |   |      |      |       |               |
| $V_{SD}$                       | source-drain voltage              | $I_S = -1.7 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$   | -    | -0.7 | -1.2  | V             |
| $t_{rr}$                       | reverse recovery time             | $I_S = -1.7 \text{ A}; dI_S/dt = 100 \text{ A}/\mu\text{s}; V_{GS} = -4.5 \text{ V}; V_{DS} = -10 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | -    | 26   | -     | ns            |
| $Q_r$                          | recovered charge                  |   | -    | 10   | -     | nC            |
| $t_a$                          | reverse recovery rise time        |   | -    | 6    | -     | ns            |
| $t_b$                          | reverse recovery fall time        |   | -    | 20   | -     | ns            |

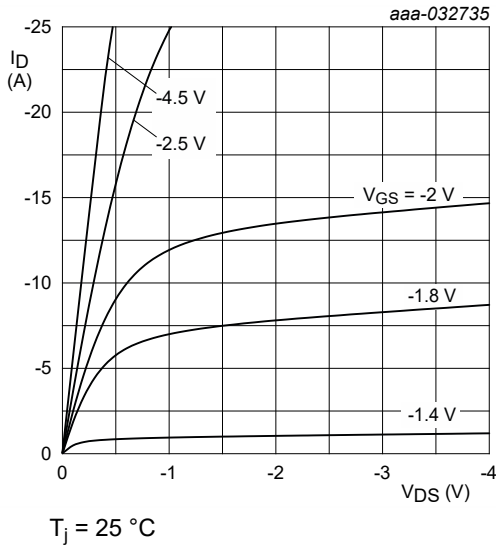


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

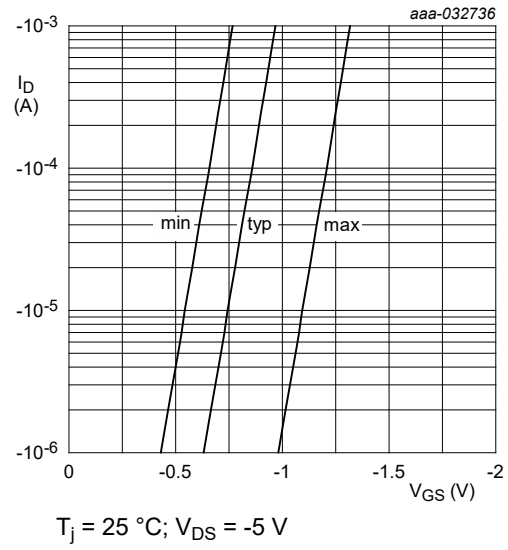


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

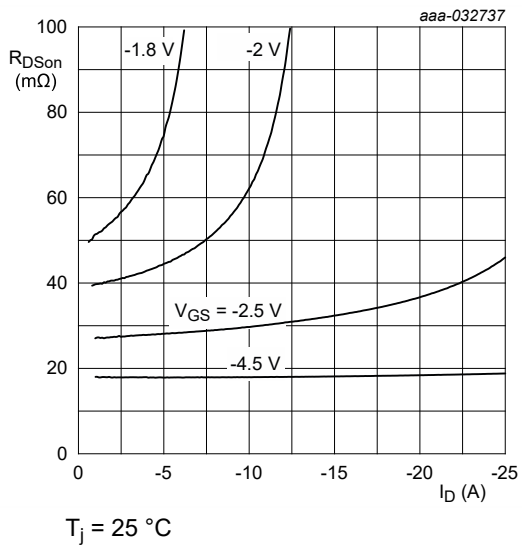


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

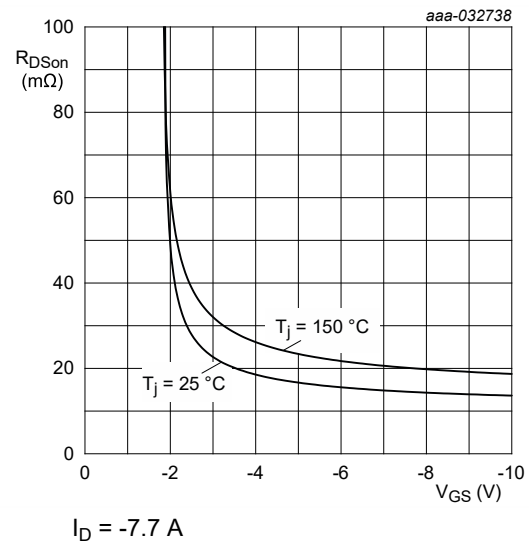


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

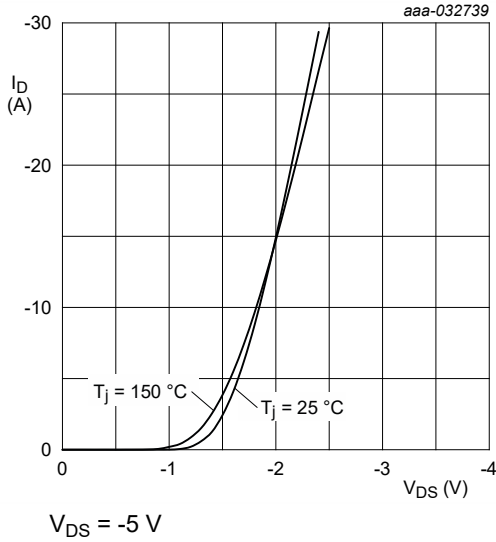
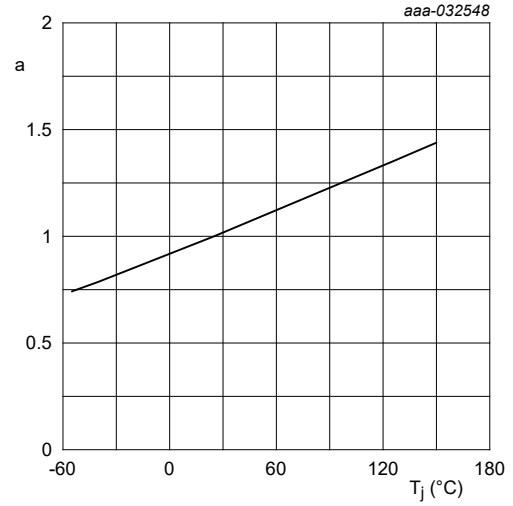


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values



$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

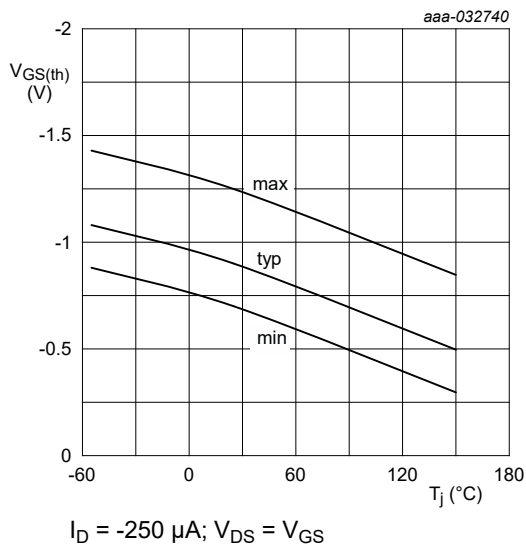


Fig. 12. Gate-source threshold voltage as a function of junction temperature

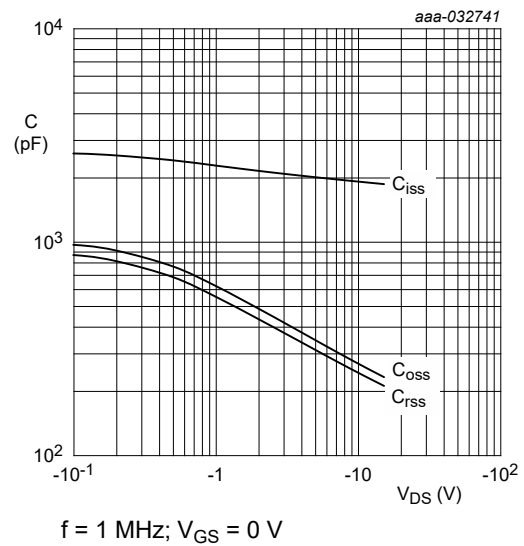
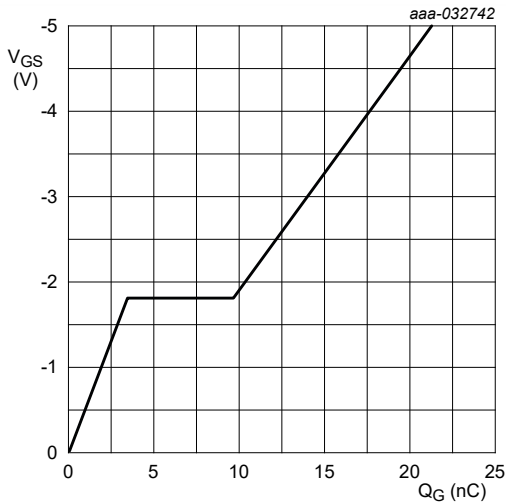


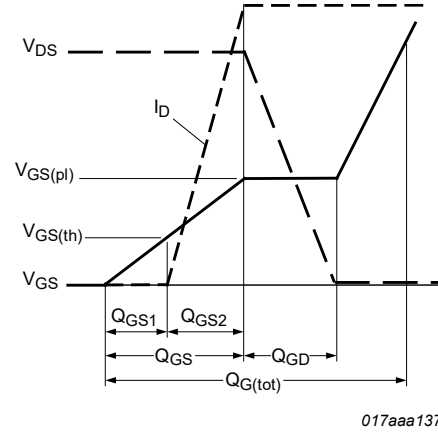
Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



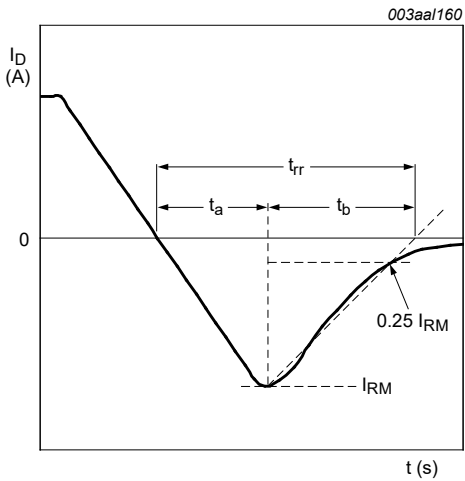


$V_{DS} = -10\text{ V}; I_D = -7.7\text{ A}; T_j = 25\text{ }^\circ\text{C}$

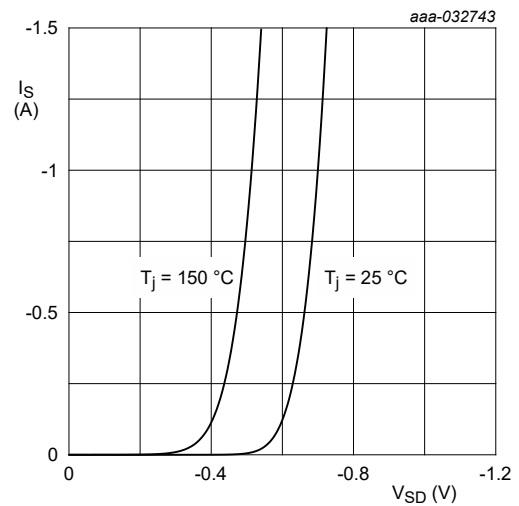
**Fig. 14. Gate-source voltage as a function of gate charge; typical values**



**Fig. 15. Gate charge waveform definitions**



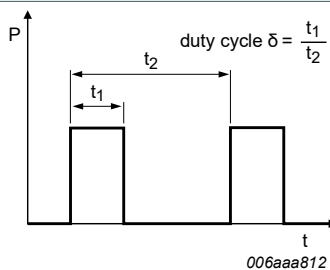
**Fig. 16. Reverse recovery timing definition**



$V_{GS} = 0\text{ V}$

**Fig. 17. Source current as a function of source-drain voltage; typical values**

## 11. Test information

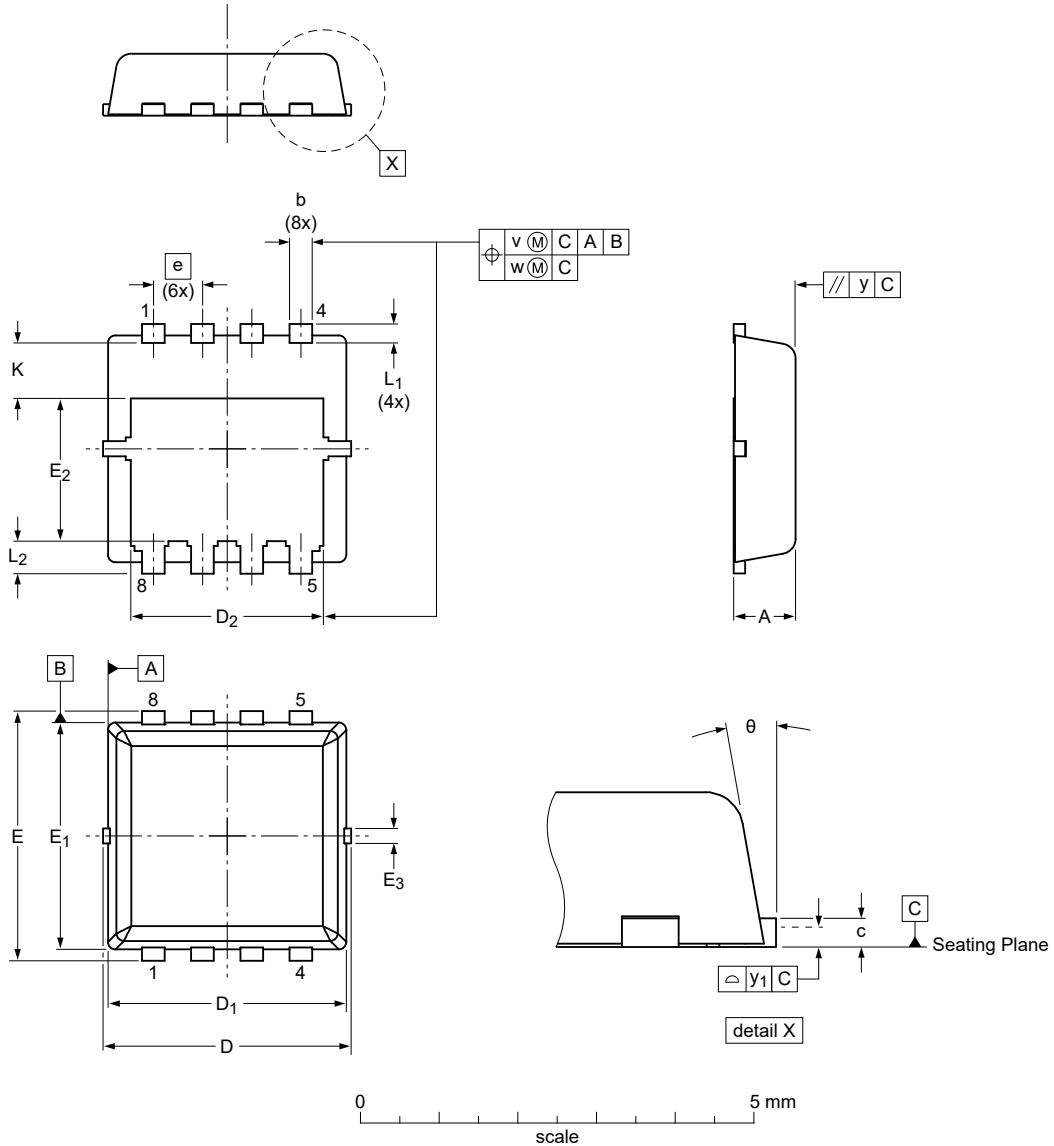


**Fig. 18. Duty cycle definition**

## 12. Package outline

MLPAK33: plastic thermal enhanced surface mounted package; mini leads; 8 terminals;  
pitch 0.65 mm; 3.3 x 3.3 x 0.8 mm body

SOT8002-1



Dimensions (mm are the original dimensions)

| Unit | A    | b    | c    | D    | D <sub>1</sub> | D <sub>2</sub> | e    | E    | E <sub>1</sub> | E <sub>2</sub> | E <sub>3</sub> | K          | L <sub>1</sub> | L <sub>2</sub> | θ   | y    | y <sub>1</sub> | v   | w    |
|------|------|------|------|------|----------------|----------------|------|------|----------------|----------------|----------------|------------|----------------|----------------|-----|------|----------------|-----|------|
| max  | 0.90 | 0.35 | 0.18 | 3.50 | 3.25           | 2.65           |      | 3.50 | 3.10           | 1.99           | 0.25           |            | 0.40           | 0.58           | 12° |      |                |     |      |
| mm   | nom  | 0.80 | 0.30 | 3.30 | 3.15           | 2.55           | 0.65 | 3.30 | 3.00           | 1.89           | 0.20           | 0.65 (ref) | 0.25           | 0.43           | 10° | 0.05 | 0.05           | 0.1 | 0.05 |
|      | min  | 0.70 | 0.25 | 3.10 | 3.05           | 2.45           |      | 3.10 | 2.90           | 1.79           | 0.15           |            | 0.10           | 0.28           | 8°  |      |                |     |      |

sot8002-1\_po

| Outline version | References |       |      |  | European projection | Issue date           |
|-----------------|------------|-------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |                      |
| SOT8002-1       |            |       |      |  |                     | 20-01-19<br>23-05-17 |

Fig. 19. Package outline MLPAK33 (SOT8002-1)

### 13. Soldering

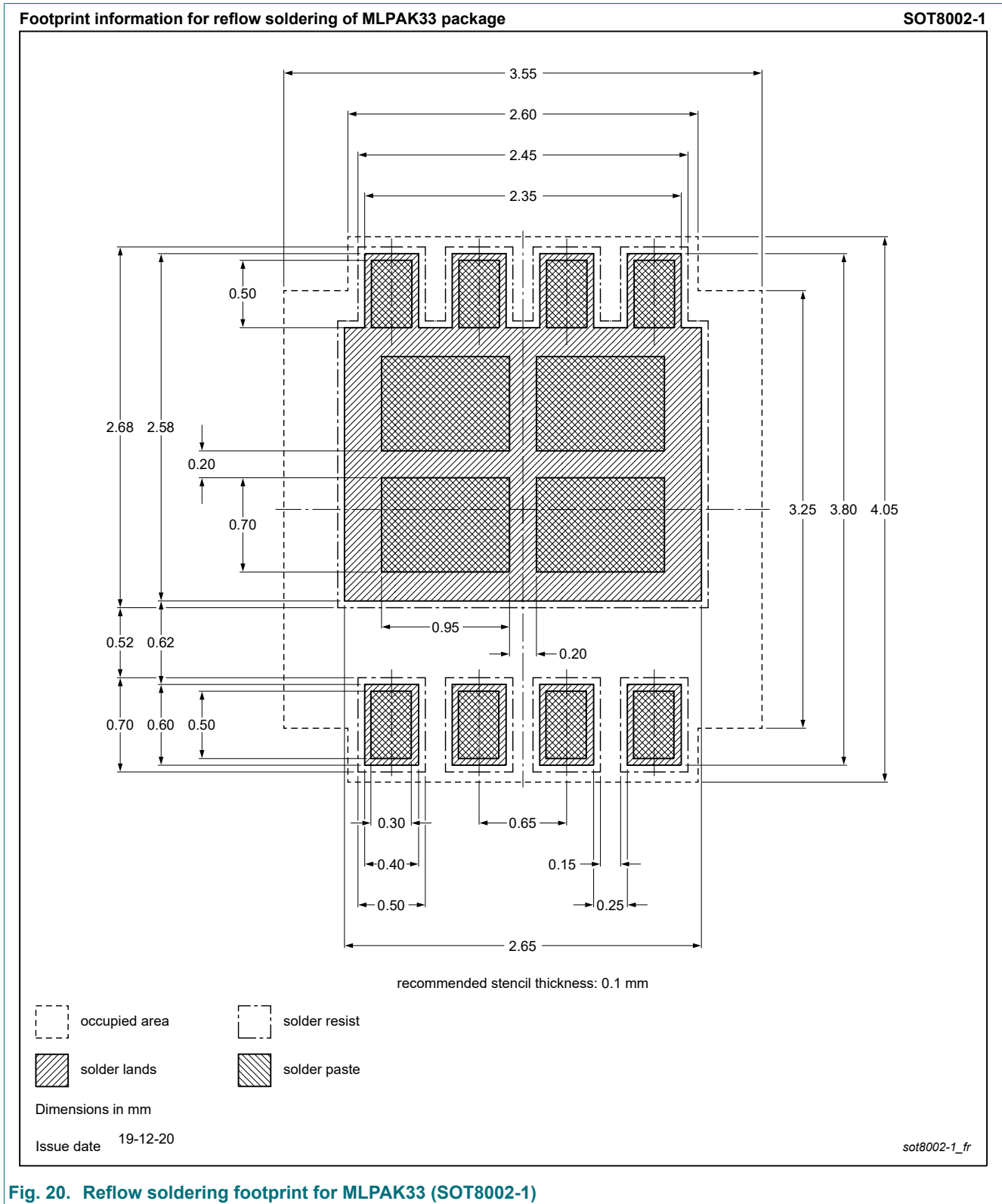


Fig. 20. Reflow soldering footprint for MLPAK33 (SOT8002-1)

## 14. Revision history

Table 8. Revision history

| Data sheet ID   | Release date                                | Data sheet status  | Change notice | Supersedes      |
|-----------------|---|--------------------|---------------|-----------------|
| PXP020-20QX v.3 | 20230731                                    | Product data sheet | -             | PXP020-20QX v.2 |
| Modifications:  | • Chapter "Package outline": drawing update |                    |               |                 |
| PXP020-20QX v.2 | 20211026                                    | Product data sheet | -             | PXP020-20QX v.1 |
| PXP020-20QX v.1 | 20210414                                    | Product data sheet | -             | -               |

## 15. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | Definition  |
|--------------------------------|--------------------|---|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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