



PXP3R7-12QU

12 V, P-channel Trench MOSFET

6 September 2021

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

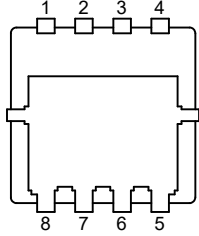
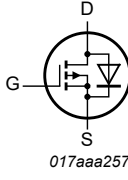
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|---|-----|-----|-------|------|
| V_{DS} | drain-source voltage | $T_j = 25\text{ °C}$ | - | - | -12 | V |
| V_{GS} | gate-source voltage | | -8 | - | 8 | V |
| I_D | drain current | $V_{GS} = -4.5\text{ V}; T_{amb} = 25\text{ °C}; t \leq 5\text{ s}$ | [1] | - | -30.6 | A |
| Static characteristics | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = -4.5\text{ V}; I_D = -18.6\text{ A}; T_j = 25\text{ °C}$ | - | 3.2 | 3.7 | mΩ |
| | | $V_{GS} = -2.5\text{ V}; I_D = -15.9\text{ A}; T_j = 25\text{ °C}$ | - | 4.1 | 5.1 | mΩ |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm².

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 |
| PXP3R7-12QU | 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 |
|-------------|--------------|
| PXP3R7-12QU | 9AR |

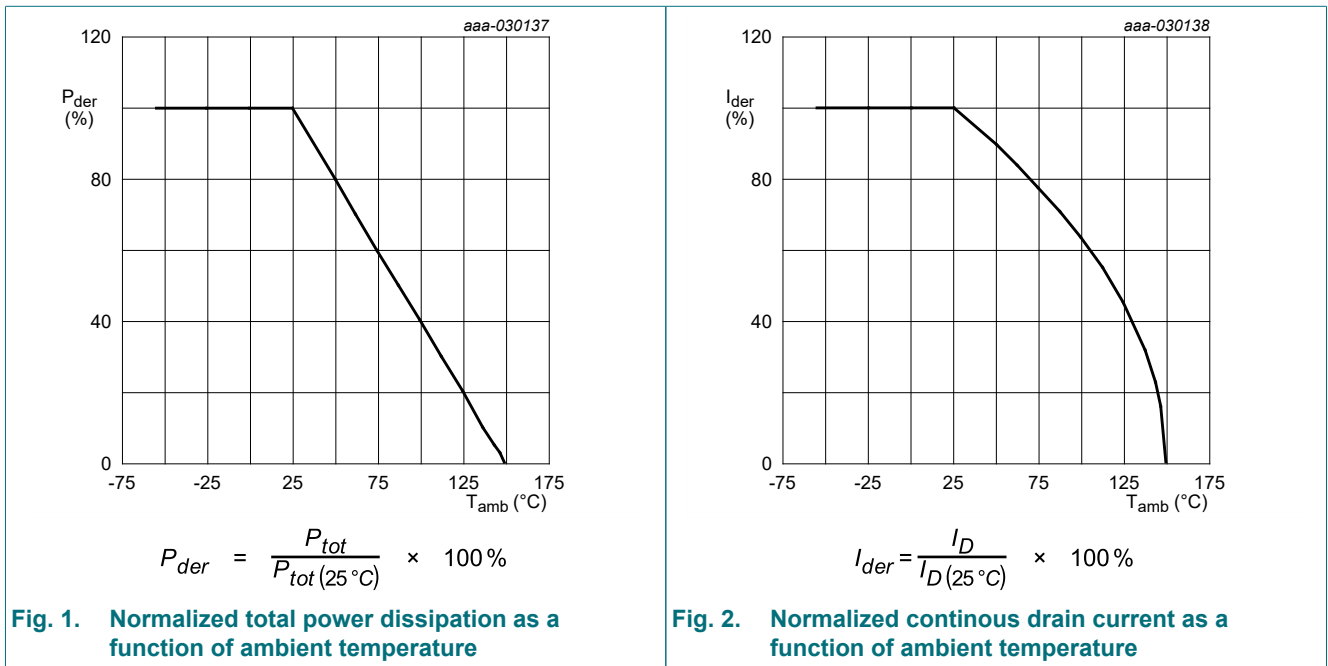
8. Limiting values

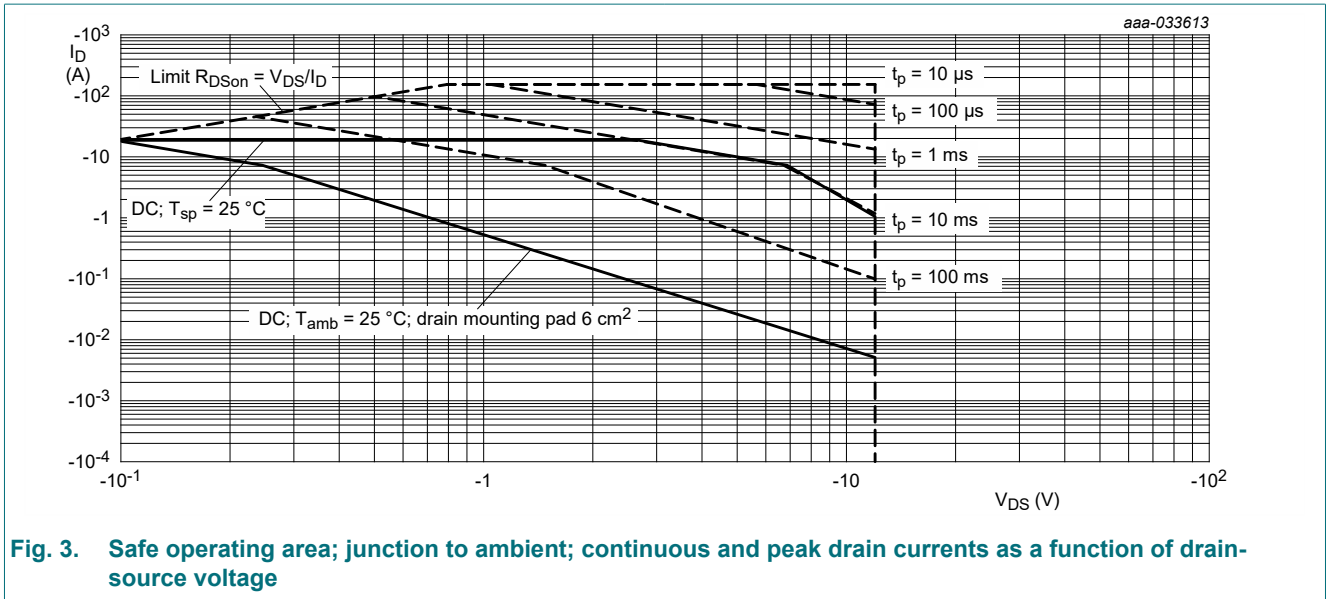
Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit | |
|---------------------------|-------------------------|--|-----|------|-------|---|
| V _{DS} | drain-source voltage | T _j = 25 °C | - | -12 | V | |
| V _{GS} | gate-source voltage | | -8 | 8 | V | |
| I _D | drain current | V _{GS} = -4.5 V; T _{amb} = 25 °C; t ≤ 5 s | [1] | - | -30.6 | A |
| | | V _{GS} = -4.5 V; T _{amb} = 25 °C | [1] | - | -18.7 | A |
| | | V _{GS} = -4.5 V; T _{amb} = 100 °C | [1] | - | -11.8 | A |
| | | V _{GS} = -4.5 V; T _{sp} = 25 °C | | - | -98.6 | A |
| I _{DM} | peak drain current | T _{amb} = 25 °C; single pulse; t _p ≤ 10 μs | - | -154 | A | |
| P _{tot} | total power dissipation | T _{amb} = 25 °C; t ≤ 5 s | [1] | - | 4.8 | W |
| | | T _{amb} = 25 °C | [1] | - | 1.8 | W |
| | | T _{sp} = 25 °C | | - | 50 | W |
| T _j | junction temperature | | -55 | 150 | °C | |
| T _{amb} | ambient temperature | | -55 | 150 | °C | |
| T _{stg} | storage temperature | | -65 | 150 | °C | |
| Source-drain diode | | | | | | |
| I _S | source current | T _{amb} = 25 °C | [1] | - | -1.7 | A |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm².





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] | - | 145 | 185 | K/W |
| | | | [2] | - | 55 | 70 | K/W |
| | | in free air; $t \leq 5$ s | [2] | - | 21 | 26 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | 1.5 | 2.5 | 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 and mounting pad for drain 6 cm².

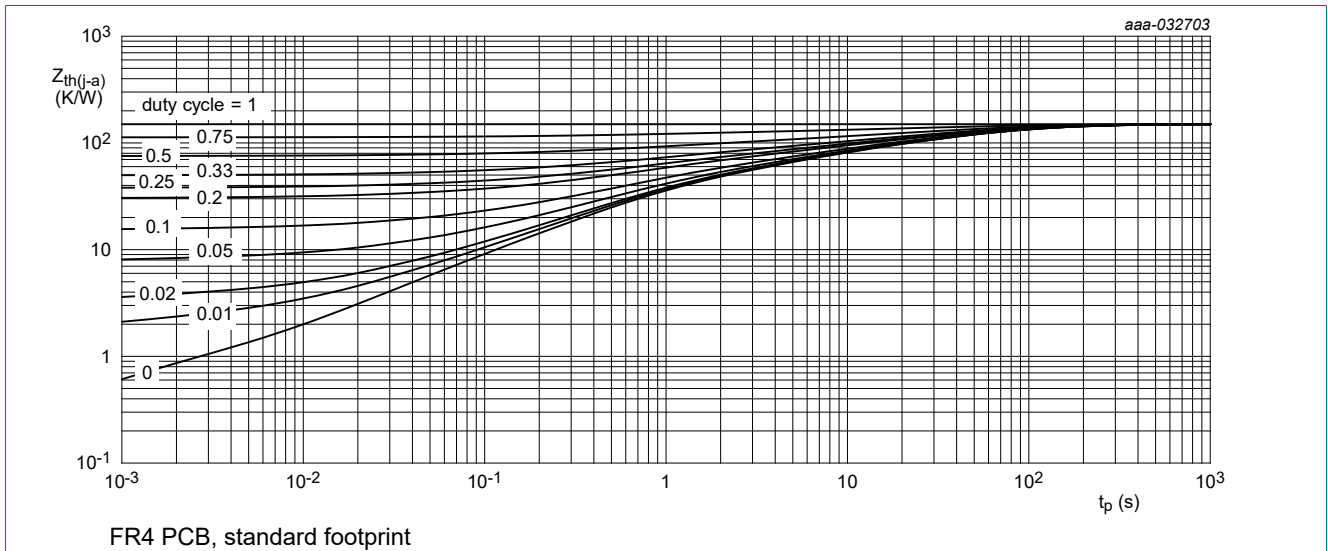


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

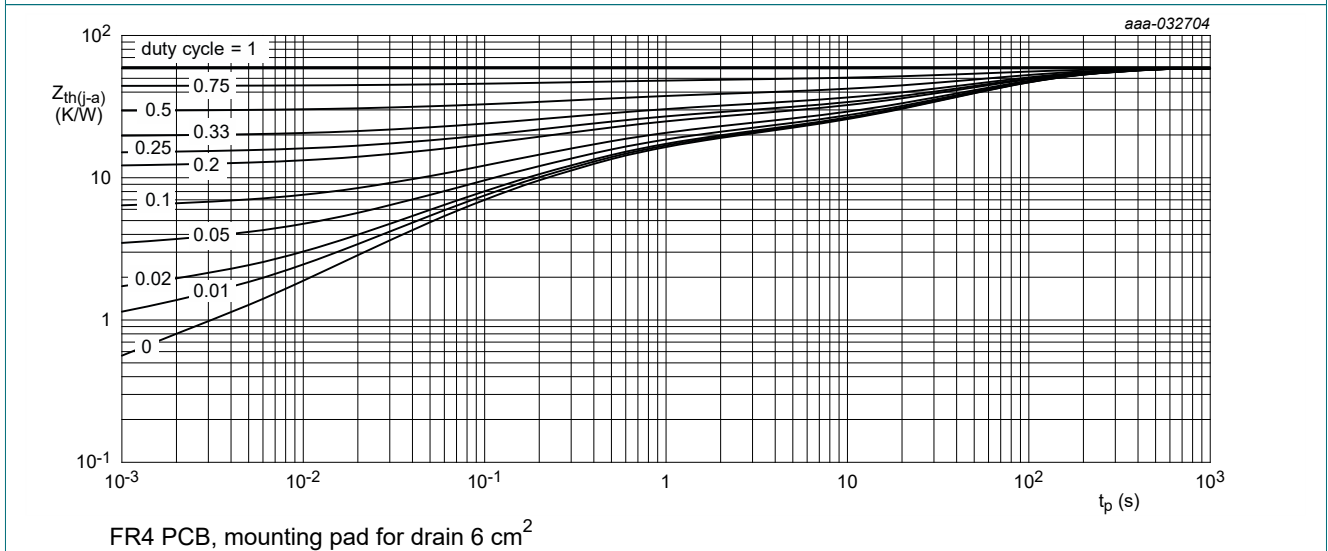


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|-----------------------------------|---|-------|------|------|---------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = -250 \mu\text{A}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$ | -12 | - | - | V |
| V_{GSth} | gate-source threshold voltage | $I_D = -250 \mu\text{A}$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ\text{C}$ | -0.47 | -0.7 | -0.9 | V |
| I_{DSS} | drain leakage current | $V_{DS} = -12 \text{ V}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | - | -1 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = -8 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | - | -100 | nA |
| | | $V_{GS} = 8 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | - | 100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = -4.5 \text{ V}$; $I_D = -18.6 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 3.2 | 3.7 | m Ω |
| | | $V_{GS} = -4.5 \text{ V}$; $I_D = -18.6 \text{ A}$; $T_j = 150 \text{ }^\circ\text{C}$ | - | 4.4 | 5.1 | m Ω |
| | | $V_{GS} = -2.5 \text{ V}$; $I_D = -15.9 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 4.1 | 5.1 | m Ω |
| | | $V_{GS} = -1.8 \text{ V}$; $I_D = -4 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 6.2 | 8.5 | m Ω |
| g_{fs} | forward transconductance | $V_{DS} = -10 \text{ V}$; $I_D = -18.6 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 65 | - | S |
| R_G | gate resistance | $f = 1 \text{ MHz}$ | - | 4.5 | - | Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS} = -6 \text{ V}$; $I_D = -15.9 \text{ A}$; $V_{GS} = -4.5 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 75 | 110 | nC |
| Q_{GS} | gate-source charge | | - | 9.8 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | - | 4.9 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | - | 4.9 | - | nC |
| Q_{GD} | gate-drain charge | | - | 20.5 | - | nC |
| V_{GSpl} | gate-source plateau voltage | $V_{DS} = -6 \text{ V}$; $I_D = -15.9 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | -1.5 | - | V |
| C_{iss} | input capacitance | $V_{DS} = -6 \text{ V}$; $f = 1 \text{ MHz}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 6500 | - | pF |
| C_{oss} | output capacitance | | - | 1500 | - | pF |
| C_{rss} | reverse transfer capacitance | | - | 1300 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = -6 \text{ V}$; $I_D = -15.9 \text{ A}$; $V_{GS} = -4.5 \text{ V}$; $R_{G(ext)} = 5 \text{ }^\circ\Omega$; $T_j = 25 \text{ }^\circ\text{C}$ | - | 8 | - | ns |
| t_r | rise time | | - | 33 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 217 | - | ns |
| t_f | fall time | | - | 177 | - | ns |
| Source-drain diode | | | | | | |
| 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 |

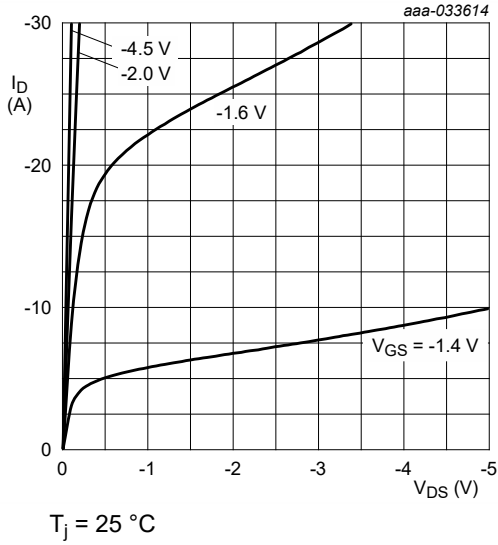


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

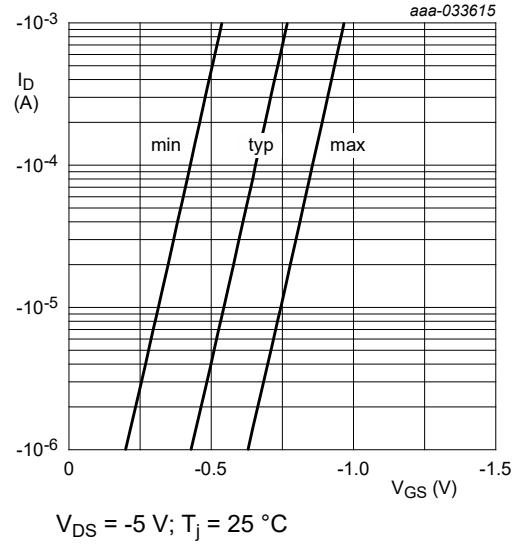


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

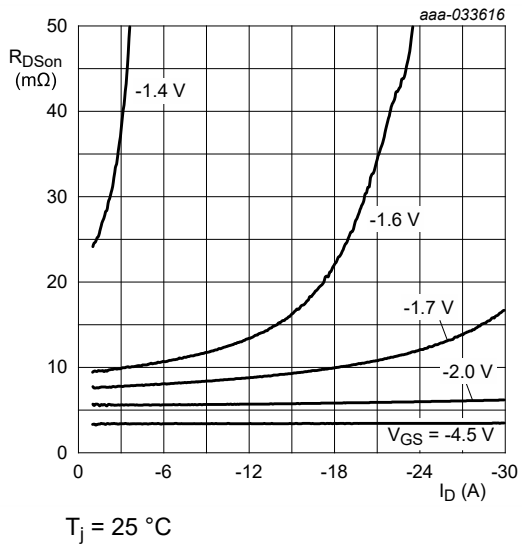


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

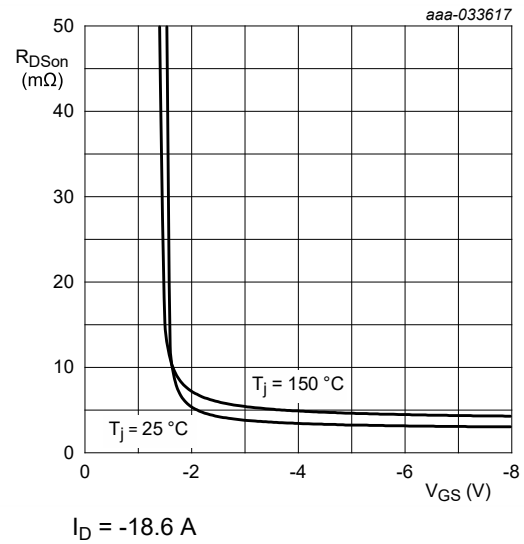


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

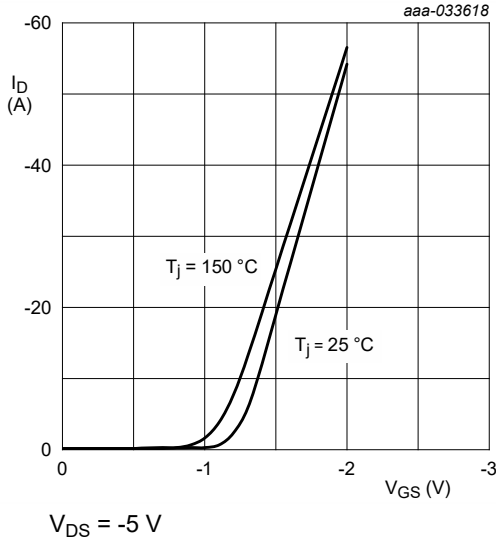
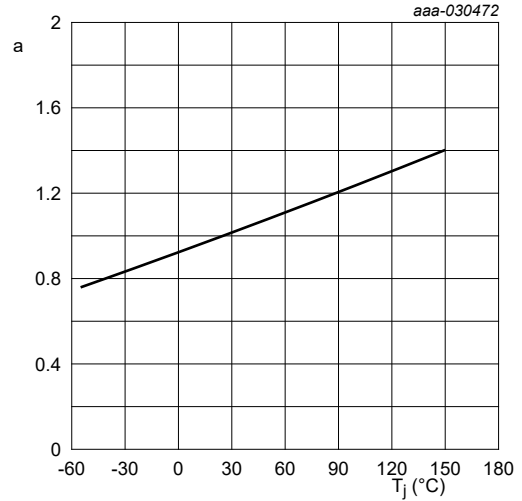


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values



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

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

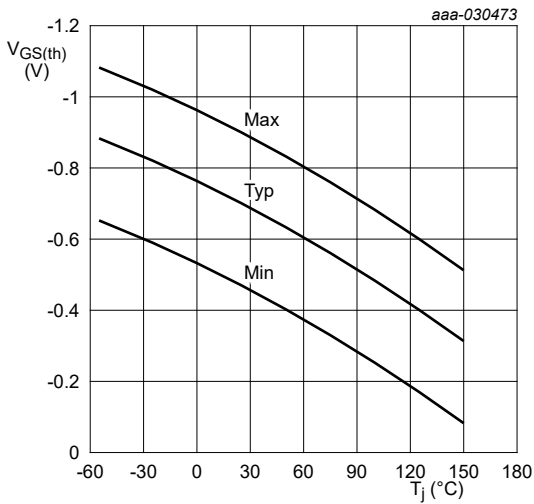


Fig. 12. Gate-source threshold voltage as a function of junction temperature

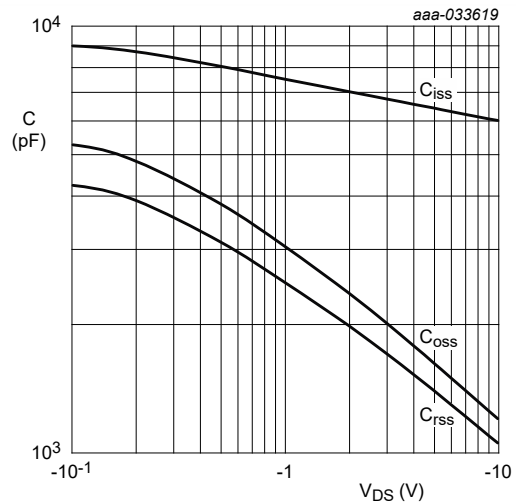
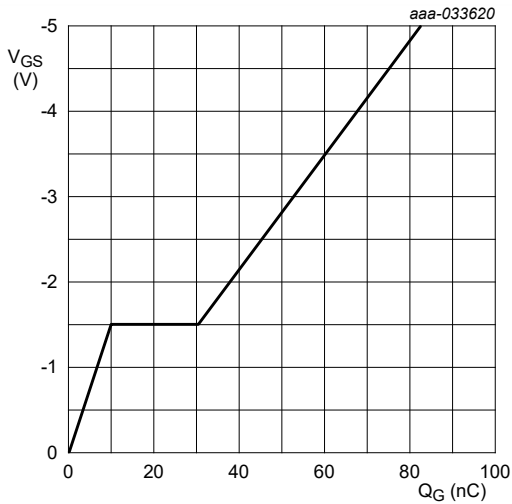


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$V_{DS} = -6 \text{ V}; I_D = -15.9 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$

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

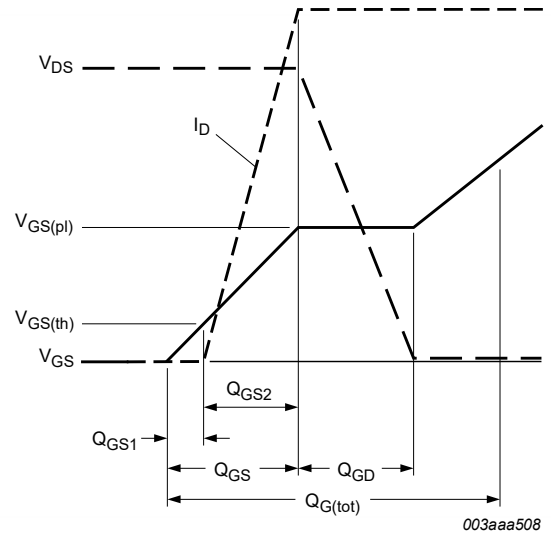
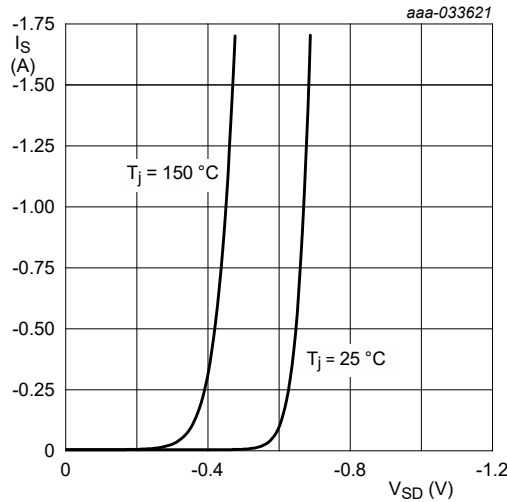


Fig. 15. Gate charge waveform definitions



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

Fig. 16. Source current as a function of source-drain voltage; typical values

11. Test information

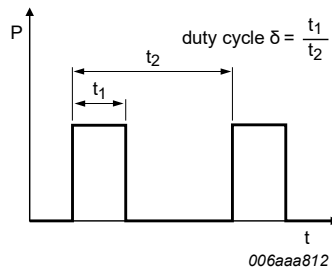
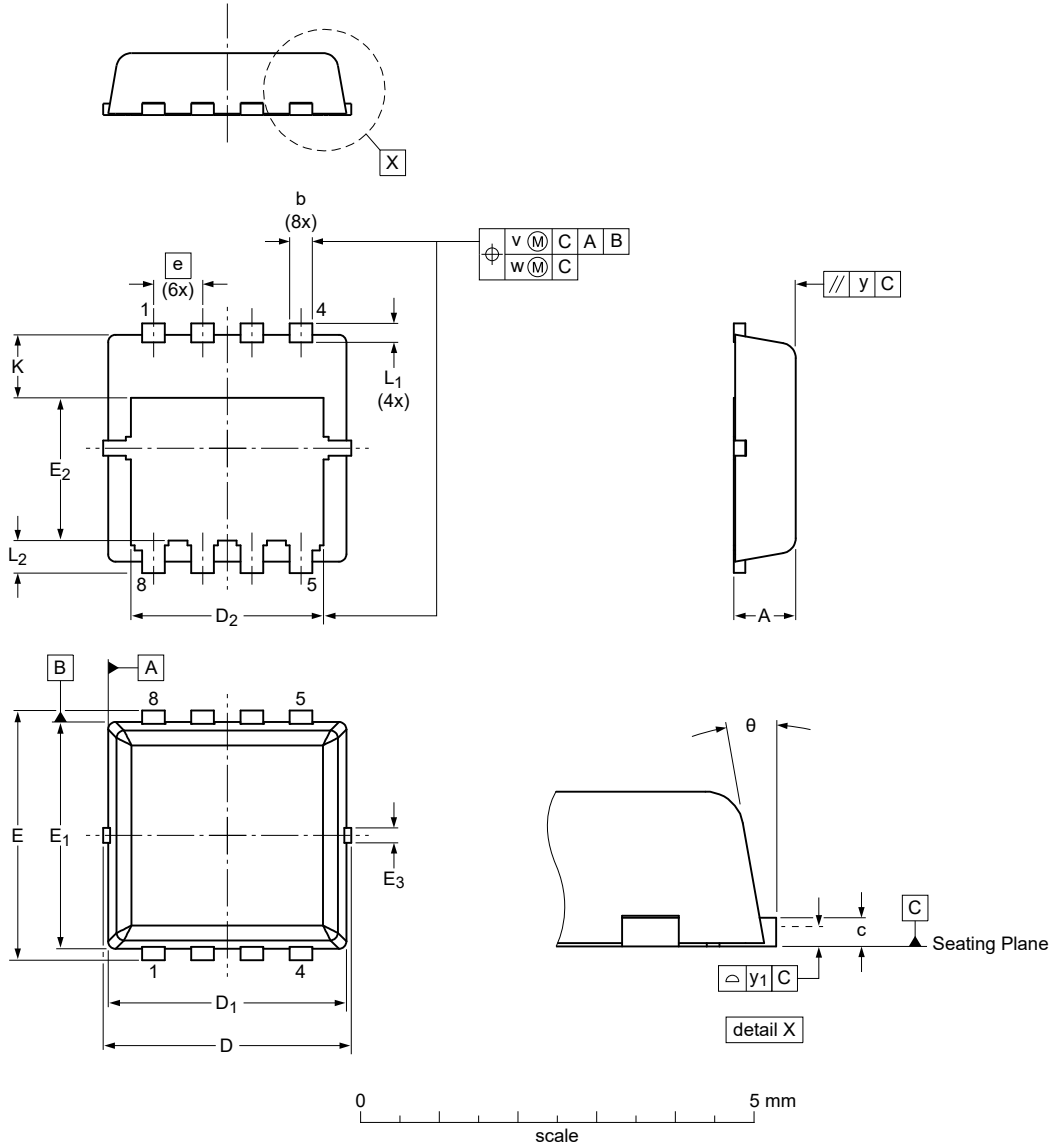


Fig. 17. Duty cycle definition

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 ₁ | D ₂ | e | E | E ₁ | E ₂ | E ₃ | K | L ₁ | L ₂ | θ | y | y ₁ | 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 | | | | | | 19-12-19 20-01-09 |

Fig. 18. Package outline MLPAK33 (SOT8002-1)

13. Soldering

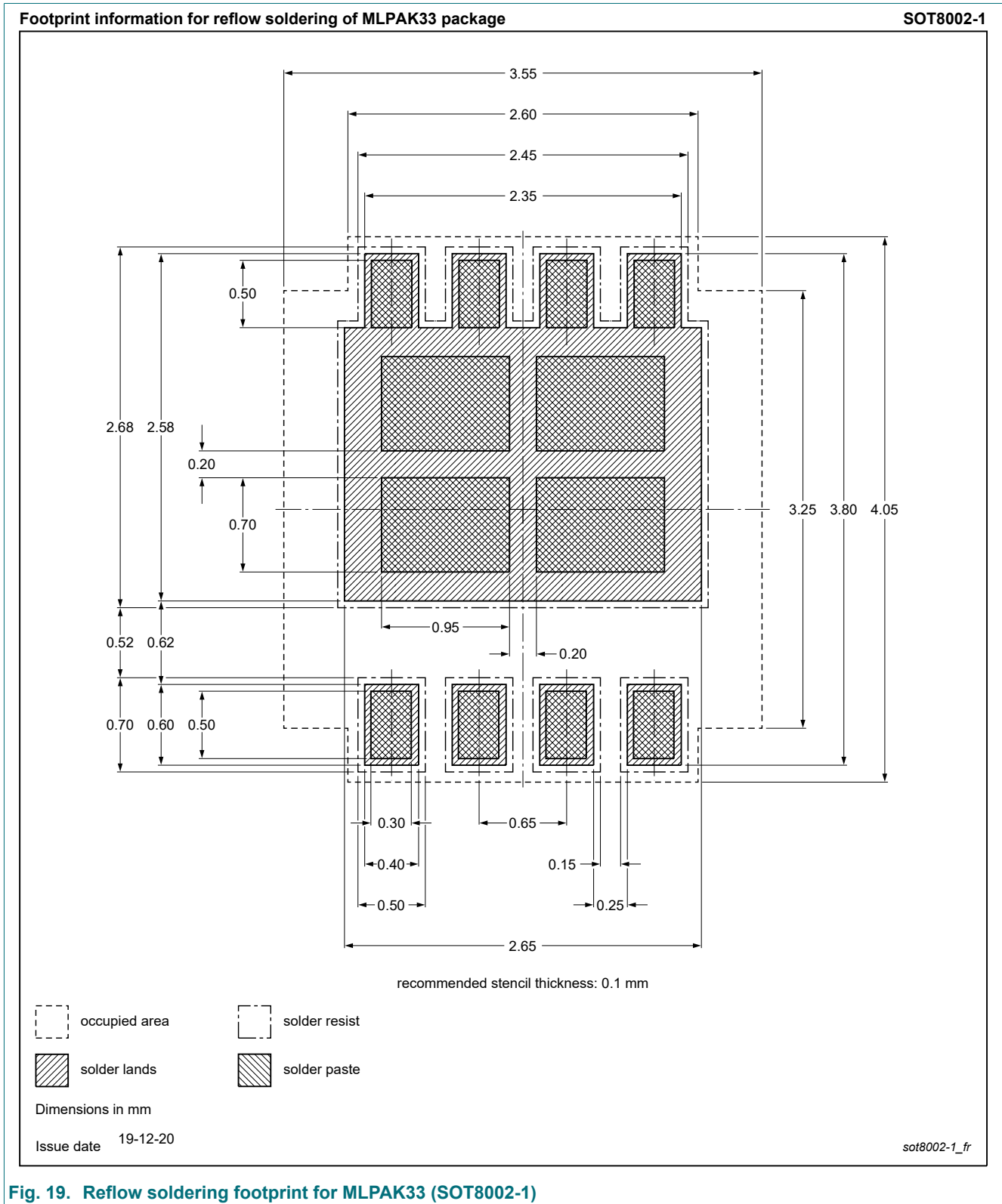


Fig. 19. Reflow soldering footprint for MLPAK33 (SOT8002-1)

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|-----------------|--------------|--------------------|---------------|------------|
| PXP3R7-12QU v.1 | 20210906 | 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. |
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Date of release: 6 September 2021
