



PSMN5R0-40MLH

N-channel 40 V, 5 mΩ, logic level MOSFET in LPAK33 using NextPower-S3 technology

27 April 2020

Product data sheet

1. General description

85 A, logic level N-channel enhancement mode MOSFET in 175 °C LPAK33 package using advanced TrenchMOS Superjunction technology. This product has been designed and qualified for high efficiency applications at high switching frequencies.

2. Features and benefits

- Avalanche rated, 100% tested
- NextPower-S3 technology delivers 'superfast switching with soft body-diode recovery'
- Low Q_{RR} , Q_G and Q_{GD} for high system efficiency, especially at high switching frequencies
- Low spiking and ringing for low EMI designs
- High reliability clip bonded and solder die attach Mini Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Exposed leads can be wave soldered, visual solder joint inspection and high quality solder joints
- Low parasitic inductance and resistance

3. Applications

- Secondary side synchronous rectification
- DC-to-DC converters
- Brushless DC motor drive
- LED lighting

4. Quick reference data

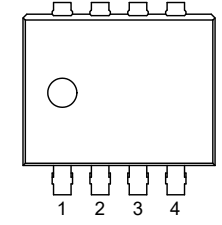
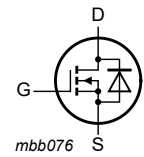
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|--|-----|-----|-----|------|
| V_{DS} | drain-source voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$ | - | - | 40 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | [1] | - | 85 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | - | - | 83 | W |
| T_j | junction temperature | | -55 | - | 175 | °C |
| Static characteristics | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10\text{ V}$; $I_D = 20\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10 | - | 3.9 | 5 | mΩ |
| | | $V_{GS} = 4.5\text{ V}$; $I_D = 20\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10 | - | 4.9 | 6.4 | mΩ |
| Dynamic characteristics | | | | | | |
| Q_{GD} | gate-drain charge | $I_D = 20\text{ A}$; $V_{DS} = 20\text{ V}$; $V_{GS} = 4.5\text{ V}$; Fig. 12 ; Fig. 13 | 0.9 | 2.9 | 5.9 | nC |
| $Q_{G(tot)}$ | total gate charge | | 8.5 | 13 | 18 | nC |

[1] 85A Continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|---|---|
| 1 | S | source |  <p>LPAK33 (SOT1210)</p> |  |
| 2 | S | source | | |
| 3 | S | source | | |
| 4 | G | gate | | |
| mb | D | Mounting base; connected to drain | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|---------------|---------|--|---------|
| | Name | Description | Version |
| PSMN5R0-40MLH | LPAK33 | Plastic, single ended surface mounted package (LPAK33); 8 leads; 0.65 mm pitch | SOT1210 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|---------------|--------------|
| PSMN5R0-40MLH | 5H0L40 |

8. Limiting values

Table 5. Limiting values

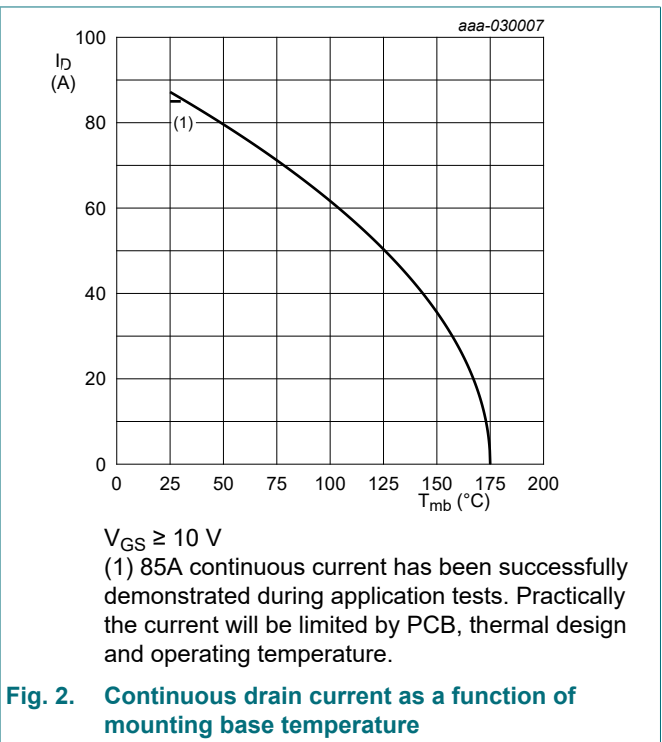
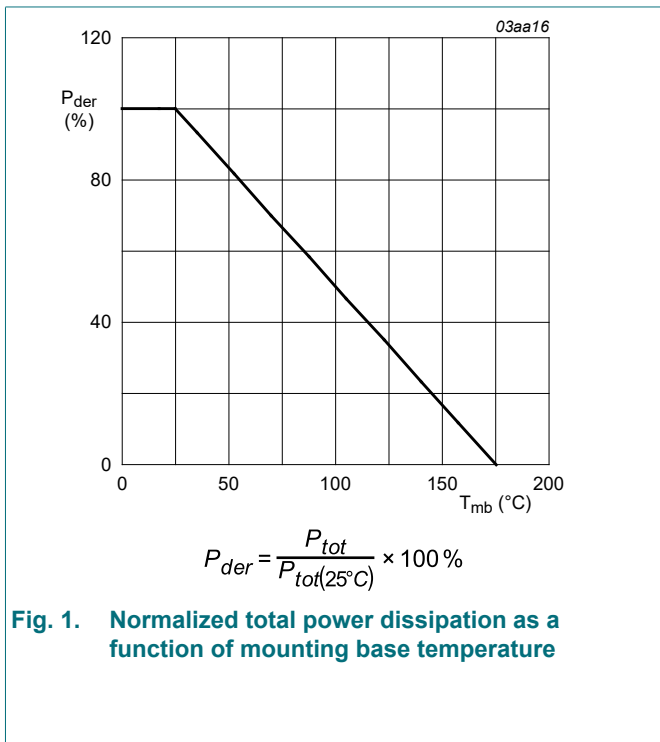
In accordance with the Absolute Maximum Rating System (IEC 60134).

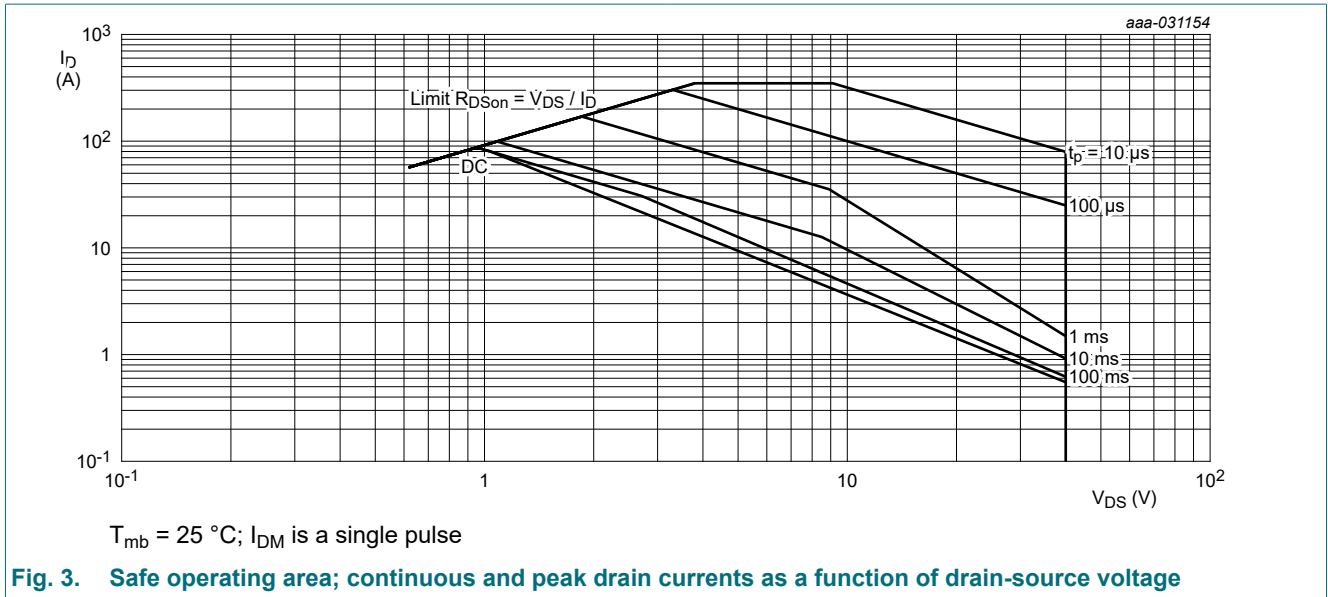
| Symbol | Parameter | Conditions | Min | Max | Unit |
|---------------------------|----------------------------|--|-----|-----|------|
| V_{DS} | drain-source voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$ | - | 40 | V |
| V_{DSM} | peak drain-source voltage | $t_p \leq 20\text{ ns}$; $f \leq 500\text{ kHz}$; $E_{DS(AL)} \leq 200\text{ nJ}$; pulsed | - | 45 | V |
| V_{DGR} | drain-gate voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$ | - | 40 | V |
| V_{GS} | gate-source voltage | | -20 | 20 | V |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | - | 83 | W |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | [1] | 85 | A |
| | | $V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2 | - | 62 | A |
| I_{DM} | peak drain current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3 | - | 349 | A |
| T_{stg} | storage temperature | | -55 | 175 | °C |
| T_j | junction temperature | | -55 | 175 | °C |
| $T_{sld(M)}$ | peak soldering temperature | | - | 260 | °C |
| Source-drain diode | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | - | 85 | A |

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| Symbol | Parameter | Conditions | | Min | Max | Unit |
|-----------------------------|--|---|-----|-----|-------|------|
| I_{SM} | peak source current | pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25 \text{ }^\circ\text{C}$ | | - | 349 | A |
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 29.6 \text{ A}$; $V_{sup} \leq 40 \text{ V}$; $R_{GS} = 50 \Omega$; $V_{GS} = 10 \text{ V}$; $T_{j(\text{init})} = 25 \text{ }^\circ\text{C}$; unclamped; $t_p = 107 \mu s$ | [2] | - | 82.7 | mJ |
| | | $I_D = 20 \text{ A}$; $V_{sup} \leq 40 \text{ V}$; $R_{GS} = 50 \Omega$; $V_{GS} = 10 \text{ V}$; $T_{j(\text{init})} = 25 \text{ }^\circ\text{C}$; unclamped; $t_p = 245 \mu s$ | [2] | - | 127.6 | mJ |
| I_{AS} | non-repetitive avalanche current | $V_{sup} \leq 40 \text{ V}$; $V_{GS} = 10 \text{ V}$; $T_{j(\text{init})} = 25 \text{ }^\circ\text{C}$; $R_{GS} = 50 \Omega$ | [2] | - | 70 | A |

- [1] 85A Continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.
- [2] Protected by 100% test

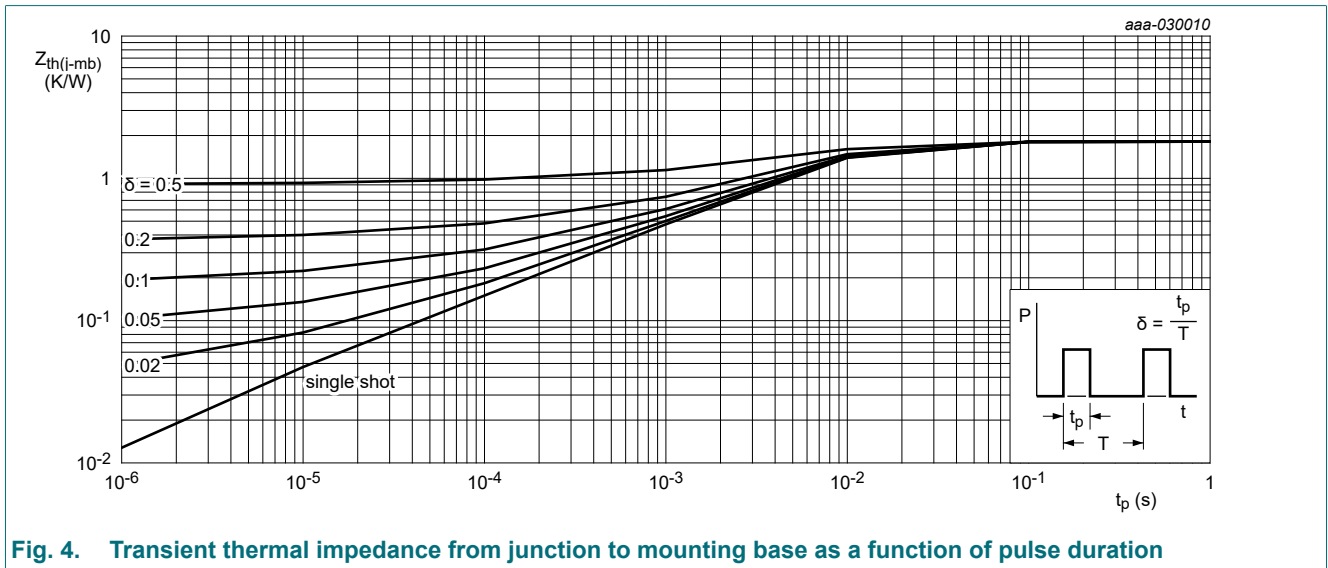


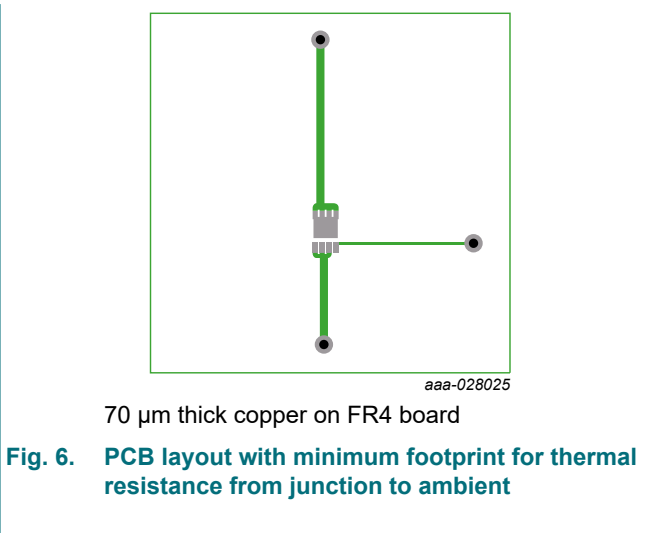
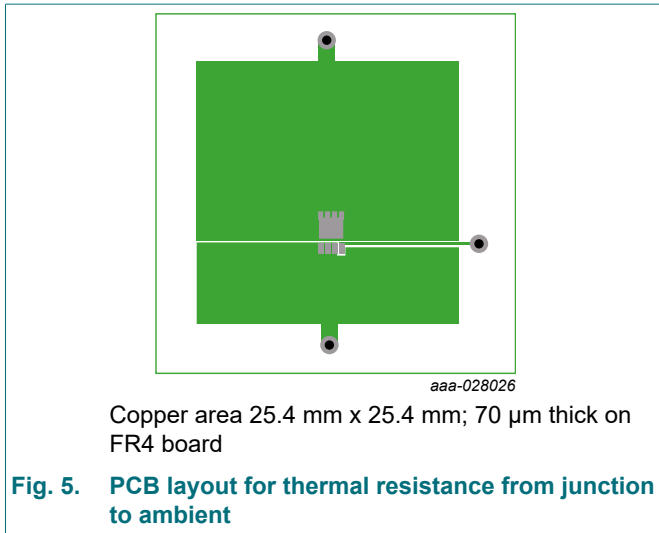


9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------|---|------------|-----|------|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 4 | - | 1.61 | 1.81 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | Fig. 5 | - | 50 | - | K/W |
| | | Fig. 6 | - | 130 | - | K/W |





10. Characteristics

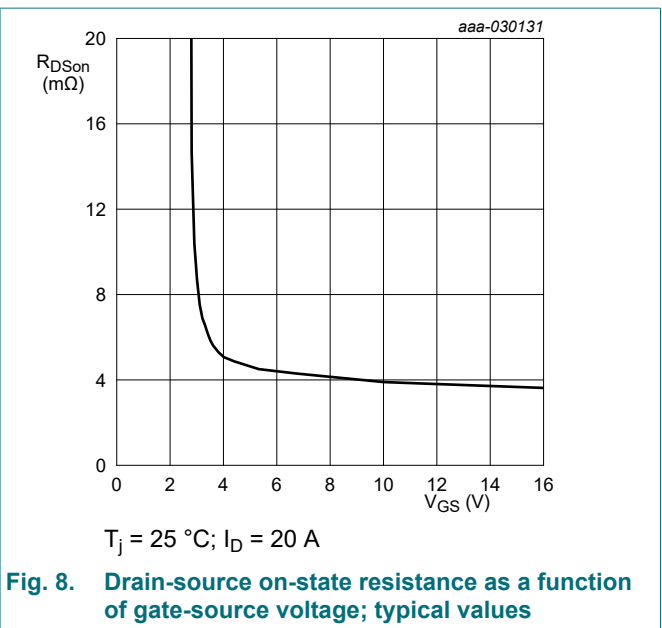
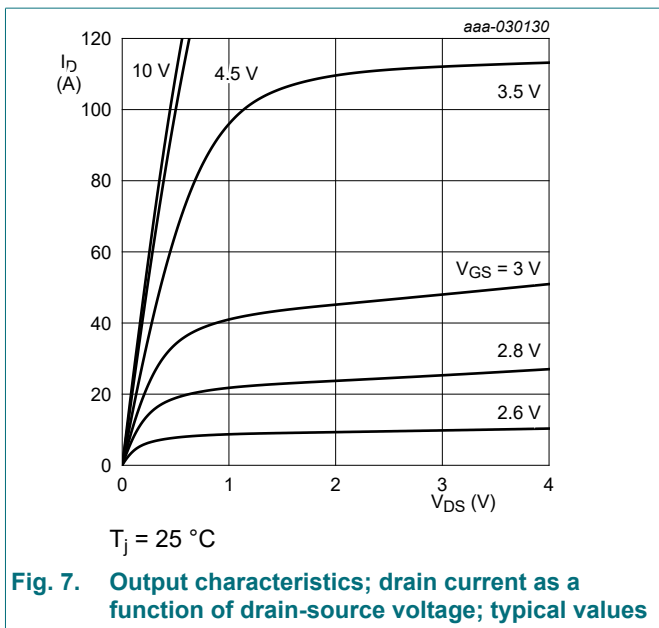
Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--|--|------|------|------|------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | 40 | - | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$ | 36 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$ | 1.45 | 1.77 | 2.15 | V |
| $\Delta V_{GS(th)}/\Delta T$ | gate-source threshold voltage variation with temperature | $25 \text{ }^\circ C \leq T_j \leq 150 \text{ }^\circ C$ | - | -4.3 | - | mV/K |
| I_{DSS} | drain leakage current | $V_{DS} = 32 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 0.04 | 1 | μA |
| | | $V_{DS} = 32 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$ | - | 0.9 | - | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| | | $V_{GS} = -16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ C;$ Fig. 10 | - | 3.9 | 5 | mΩ |
| | | $V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 175 \text{ }^\circ C;$ Fig. 11 | - | - | 10.9 | mΩ |
| | | $V_{GS} = 4.5 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ C;$ Fig. 10 | - | 4.9 | 6.4 | mΩ |
| | | $V_{GS} = 4.5 \text{ V}; I_D = 20 \text{ A}; T_j = 175 \text{ }^\circ C;$ Fig. 11 | - | - | 14 | mΩ |
| R_G | gate resistance | $f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$ | 0.3 | 0.8 | 2 | Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 20 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 4.5 \text{ V};$ Fig. 12; Fig. 13 | 8.5 | 13 | 18 | nC |
| | | $I_D = 20 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 10 \text{ V};$ Fig. 12; Fig. 13 | 18 | 28 | 39 | nC |
| | | $I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$ | - | 15 | - | nC |

N-channel 40 V, 5 mΩ, logic level MOSFET in LPAK33 using NextPower-S3 technology

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|---------------------------|-----------------------------------|---|------|------|------|------|----|
| Q_{GS} | gate-source charge | $I_D = 20\text{ A}; V_{DS} = 20\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12 ; Fig. 13 | 3 | 4.9 | 7.4 | nC | |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | 1.7 | 2.9 | 4.3 | nC | |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | 1.2 | 2 | 2.8 | nC | |
| Q_{GD} | gate-drain charge | | 0.9 | 2.9 | 5.9 | nC | |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D = 20\text{ A}; V_{DS} = 20\text{ V};$ Fig. 12 ; Fig. 13 | - | 2.8 | - | V | |
| C_{iss} | input capacitance | $V_{DS} = 20\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C};$ Fig. 14 | 1230 | 1892 | 2649 | pF | |
| C_{oss} | output capacitance | | 318 | 490 | 686 | pF | |
| C_{rss} | reverse transfer capacitance | | 20 | 68 | 150 | pF | |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 20\text{ V}; R_L = 1\text{ } \Omega; V_{GS} = 4.5\text{ V};$ $R_{G(ext)} = 5\text{ } \Omega$ | - | 18 | - | ns | |
| t_r | rise time | | - | 22 | - | ns | |
| $t_{d(off)}$ | turn-off delay time | | - | 17 | - | ns | |
| t_f | fall time | | - | 12 | - | ns | |
| Q_{oss} | output charge | $V_{GS} = 0\text{ V}; V_{DS} = 20\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C}$ | - | 15 | - | nC | |
| Source-drain diode | | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 20\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 15 | - | 0.82 | 1 | V | |
| t_{rr} | reverse recovery time | $I_S = 20\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V};$ Fig. 16 | - | 24 | - | ns | |
| Q_r | recovered charge | | [1] | - | 18 | - | nC |
| t_a | reverse recovery rise time | | - | - | 15 | - | ns |
| t_b | reverse recovery fall time | | - | - | 10 | - | ns |
| | | | | | | | |

[1] includes capacitive recovery



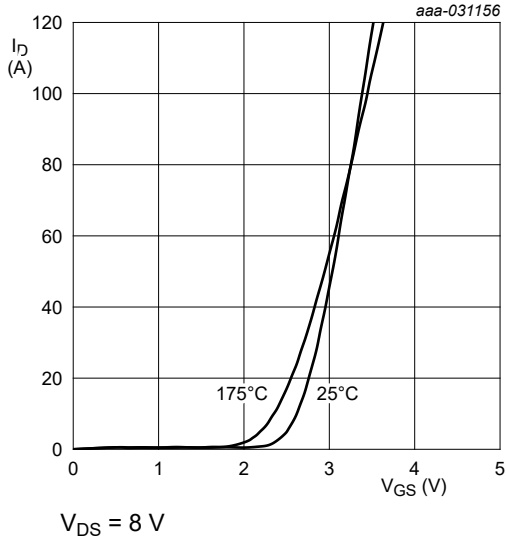


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

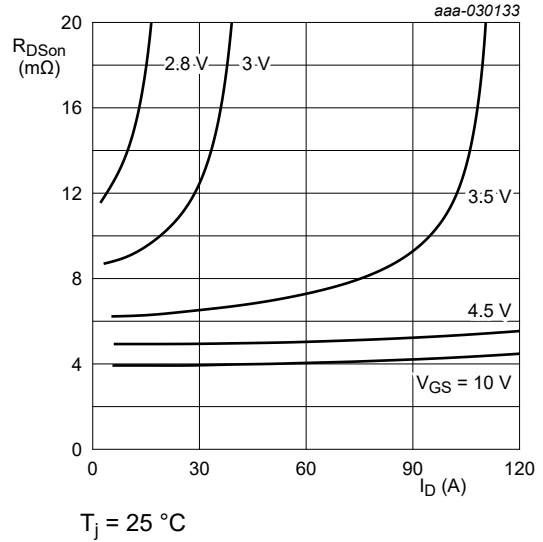


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

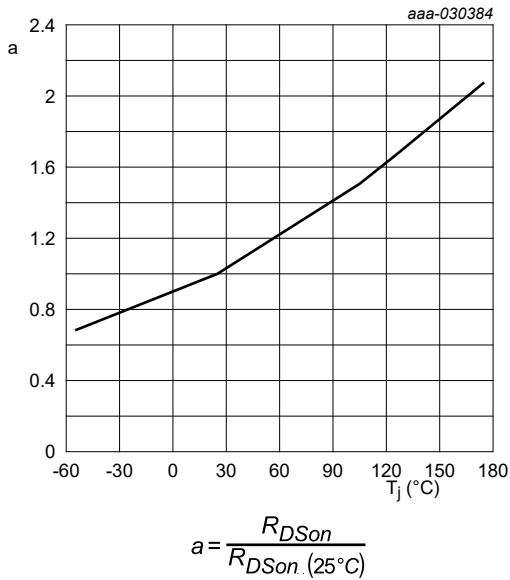


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

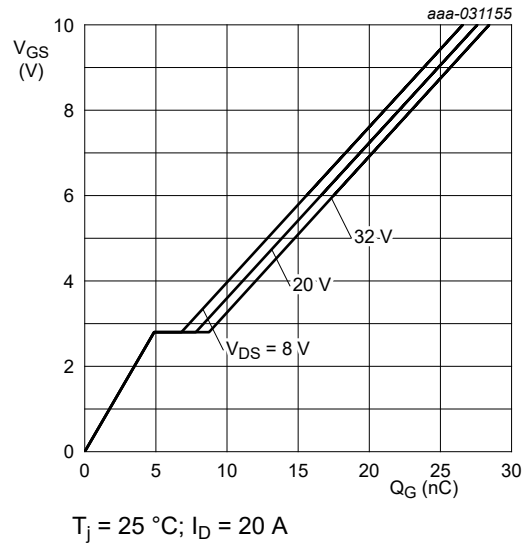


Fig. 12. Gate-source voltage as a function of gate charge; typical values

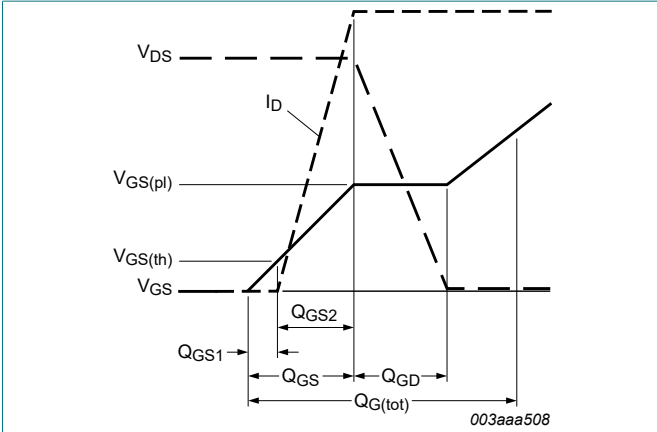
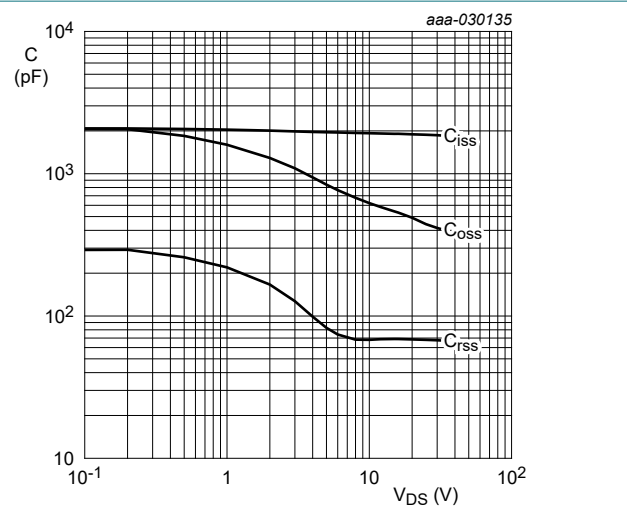
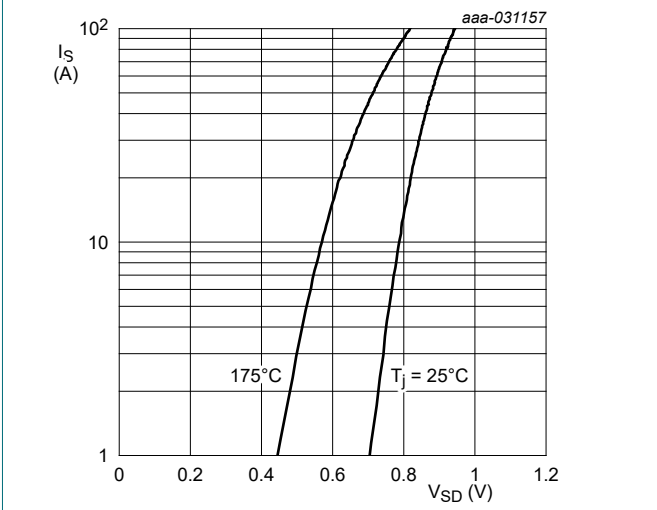


Fig. 13. Gate charge waveform definitions



$V_{GS} = 0$ V; $f = 1$ MHz

Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$V_{GS} = 0$ V

Fig. 15. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

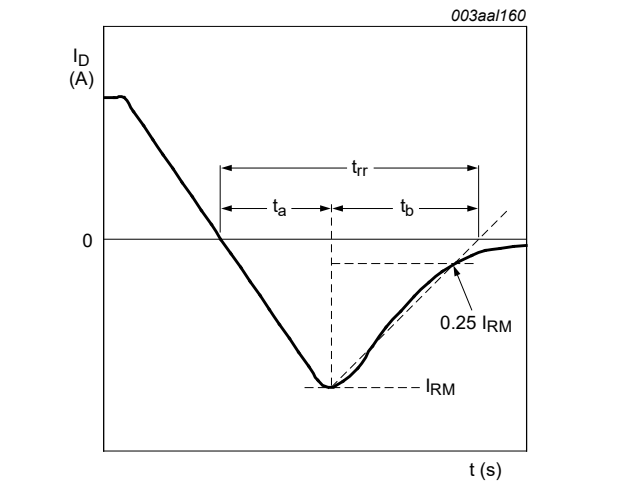


Fig. 16. Reverse recovery timing definition

11. Package outline

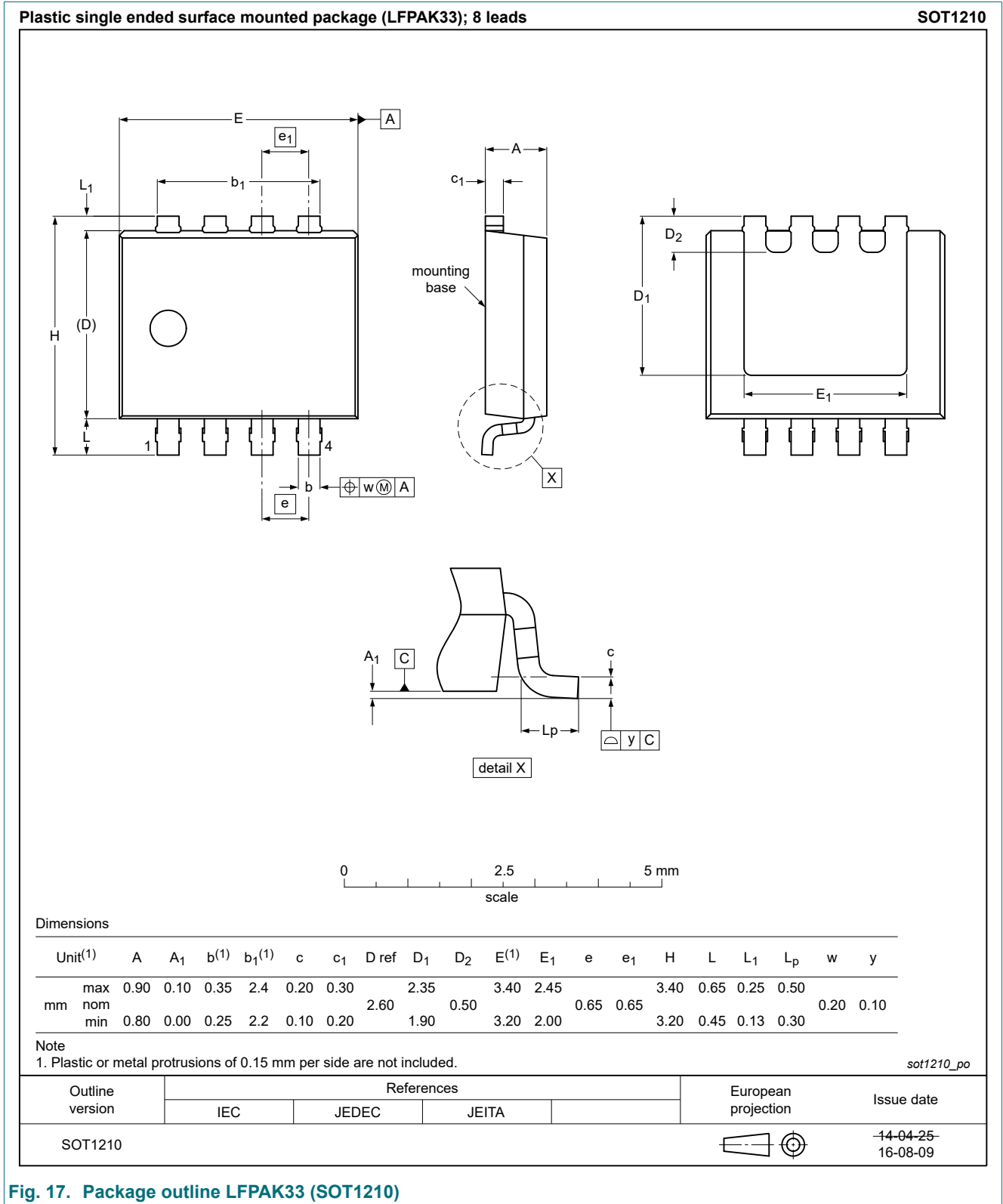


Fig. 17. Package outline LPAK33 (SOT1210)

12. Soldering

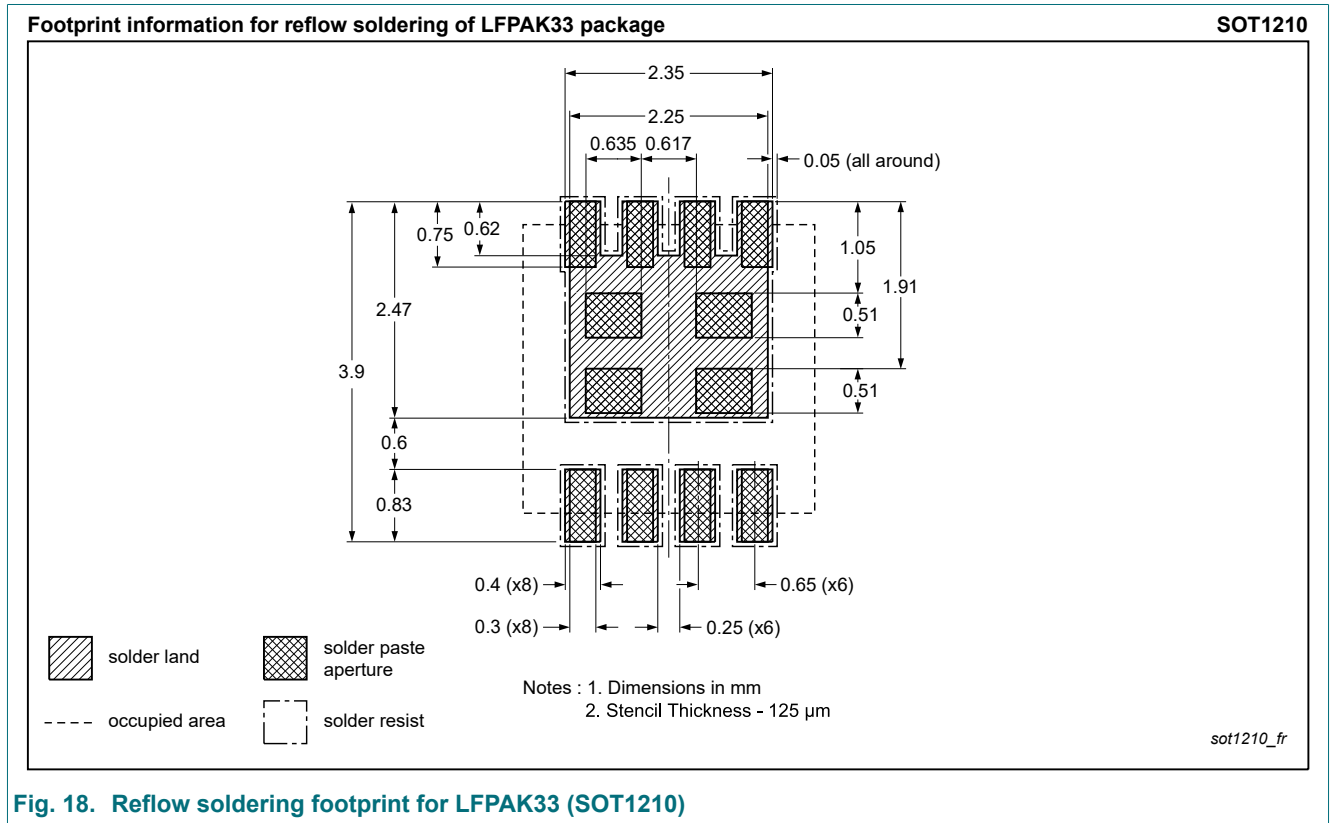


Fig. 18. Reflow soldering footprint for LPAK33 (SOT1210)

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| Document status [1][2] | Product status [3] | Definition |
|--------------------------------|--------------------|---|
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- [2] The term 'short data sheet' is explained in section "Definitions".
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Date of release: 27 April 2020
