



NX138BKH

60 V, N-channel Trench MOSFET

1 September 2020

Product data sheet

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a leadless ultra small DFN0606-3 (SOT8001) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Low threshold voltage
- Very fast switching
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 2 kV HBM
- Leadless ultra small and ultra thin SMD plastic package: 0.62 x 0.62 x 0.37 mm

3. Applications

- Relay driver
- High-speed line driver
- Low-side loadswitch
- Switching circuits

4. Quick reference data

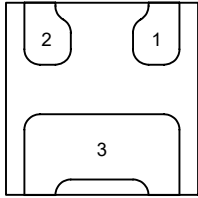
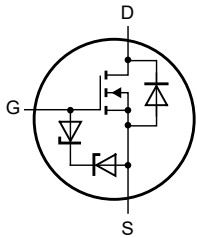
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|---|-----|-----|-----|----------|
| V_{DS} | drain-source voltage | $T_j = 25\text{ °C}$ | - | - | 60 | V |
| V_{GS} | gate-source voltage | | -20 | - | 20 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$ | [1] | - | 380 | mA |
| Static characteristics | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 380\text{ mA}; T_j = 25\text{ °C}$ | - | 1.8 | 2.3 | Ω |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 1 cm².

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-------------|--|--|
| 1 | G | gate |  <p>Transparent top view DFN0606-3 (SOT8001)</p> |  <p>017aaa255</p> |
| 2 | S | source | | |
| 3 | D | drain | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|-----------|--|---------|
| | Name | Description | Version |
| NX138BKH | DFN0606-3 | plastic, leadless ultra small package; 3 terminals; body 0.62 x 0.62 x 0.37 mm | SOT8001 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| NX138BKH | 0001 1100 |

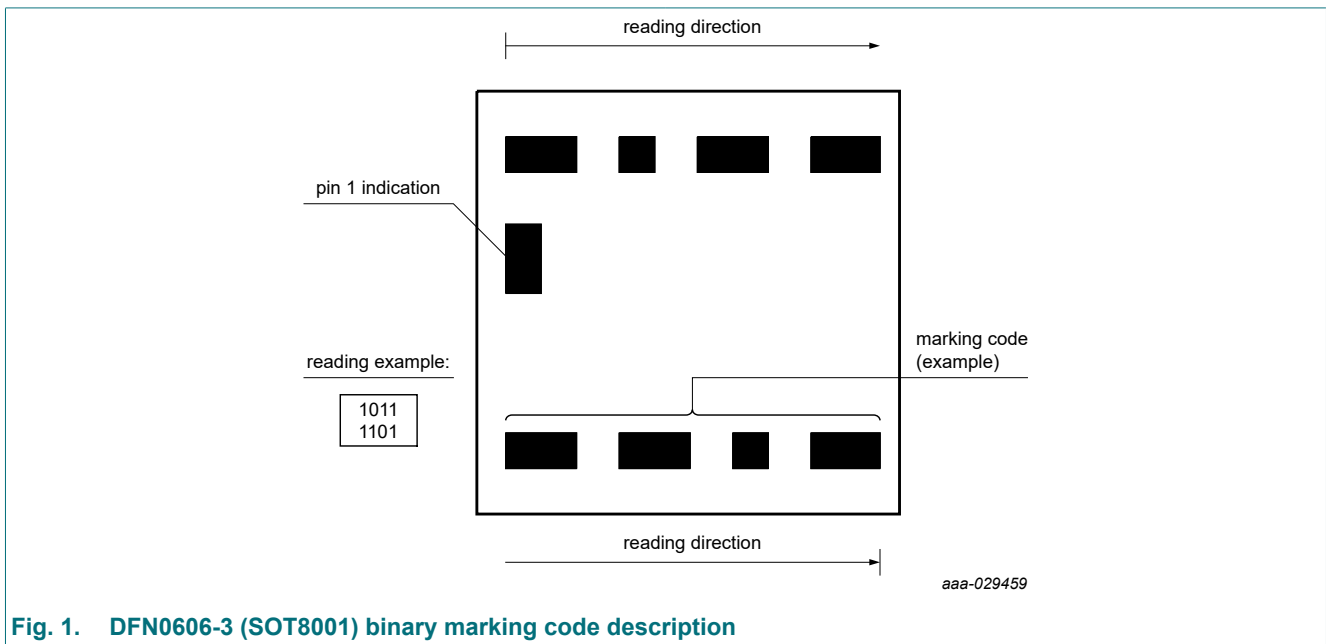


Fig. 1. DFN0606-3 (SOT8001) binary marking code description

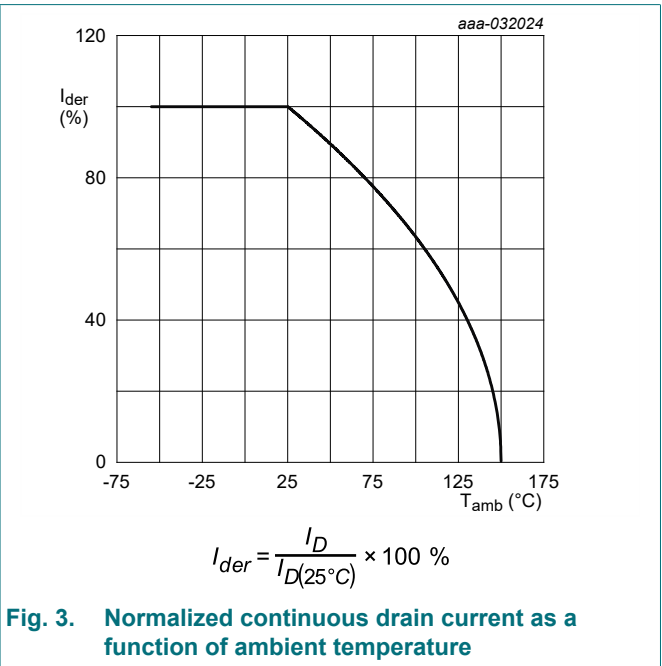
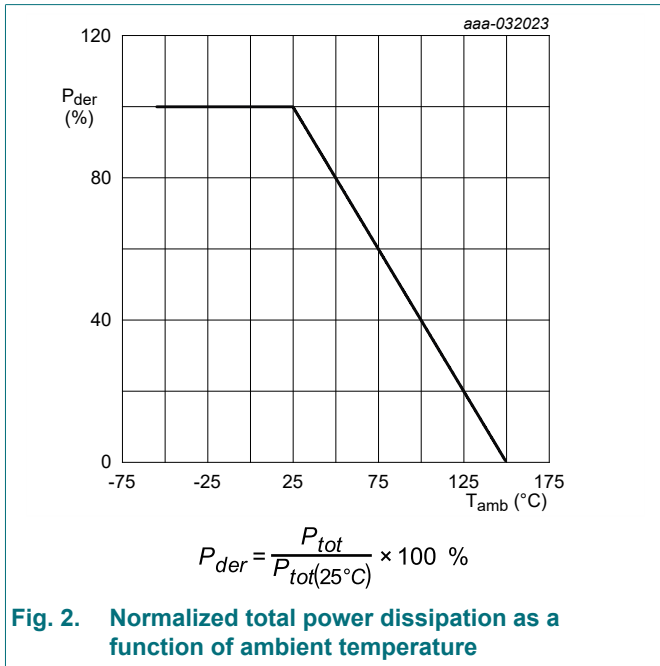
8. Limiting values

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 | | - | 60 | V |
| V _{GS} | gate-source voltage | | | -20 | 20 | V |
| I _D | drain current | V _{GS} = 10 V; T _{amb} = 25 °C | [1] | - | 380 | mA |
| | | V _{GS} = 10 V; T _{amb} = 100 °C | [1] | - | 240 | mA |
| I _{DM} | peak drain current | T _{amb} = 25 °C; single pulse; t _p ≤ 10 μs | | - | 1.5 | A |
| P _{tot} | total power dissipation | T _{amb} = 25 °C | [2] | - | 380 | mW |
| | | | [1] | - | 710 | mW |
| | | T _{sp} = 25 °C | | - | 2.8 | 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] | - | 380 | mA |

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



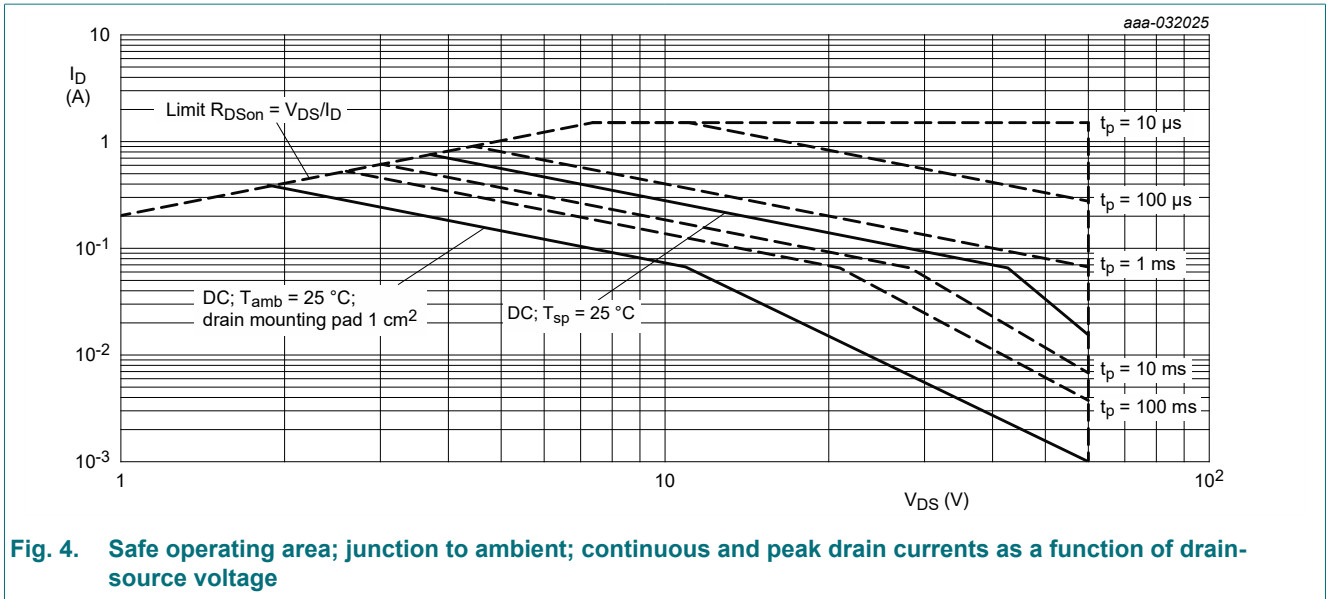


Fig. 4. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

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] | - | 285 | 330 | K/W |
| | | | [2] | - | 150 | 175 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | 40 | 45 | 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 1 cm².

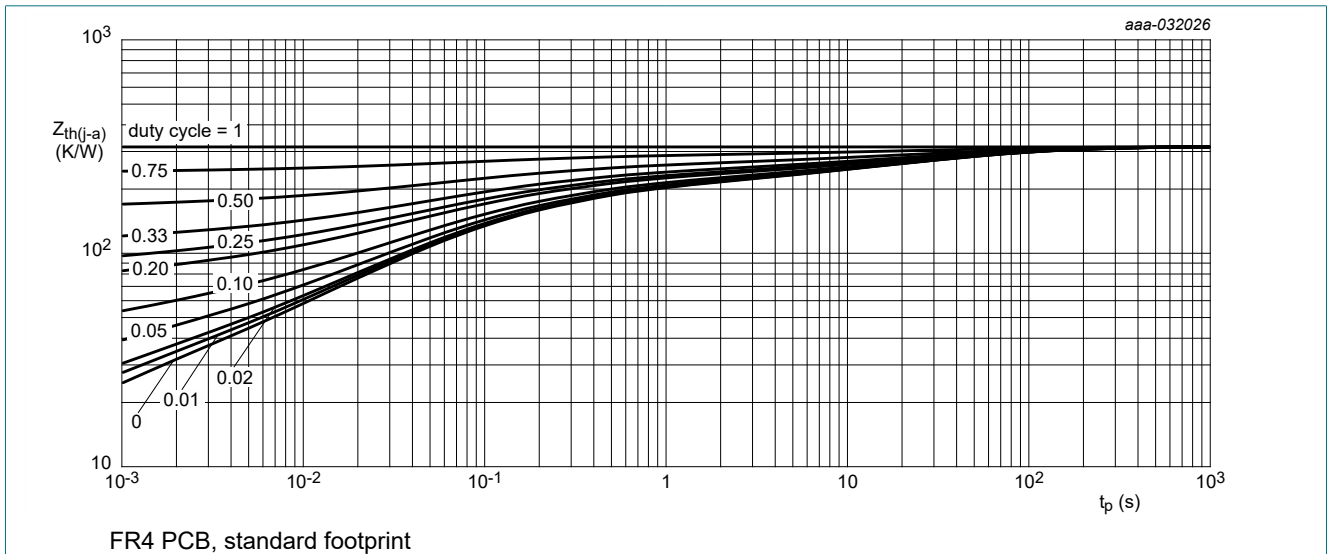


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

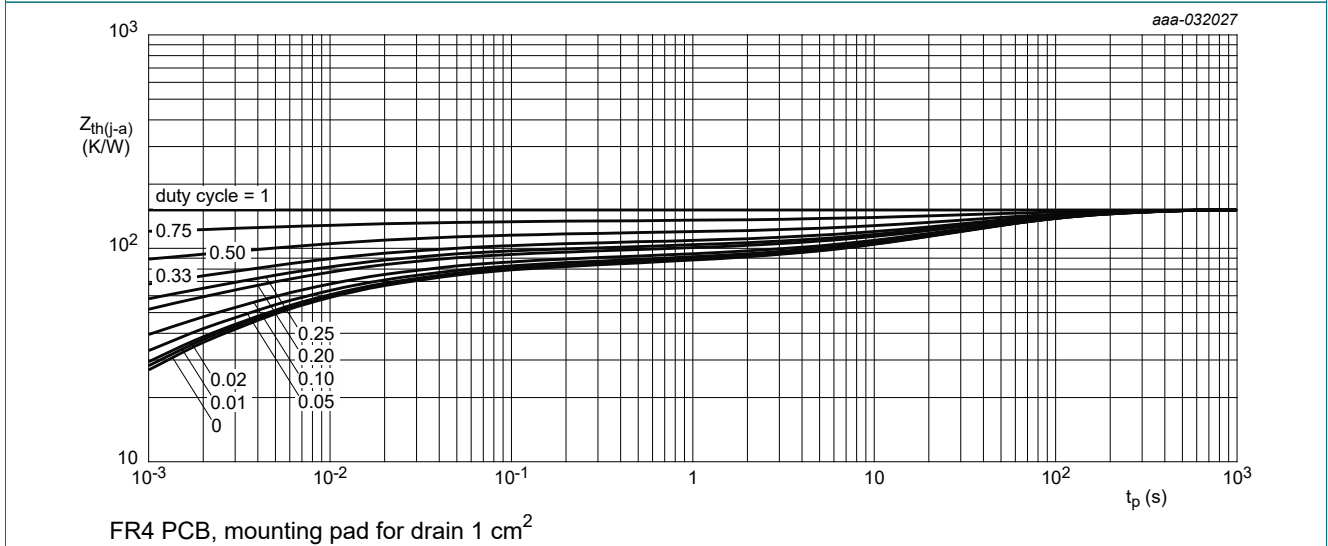


Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|------|----------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | 60 | - | - | V |
| V_{GSth} | gate-source threshold voltage | $I_D = 250 \mu A$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ C$ | 0.5 | 1 | 1.5 | V |
| I_{DSS} | drain leakage current | $V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 1 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 10 | μA |
| | | $V_{GS} = -20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | -10 | μA |
| | | $V_{GS} = 10 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 1 | μA |
| | | $V_{GS} = -10 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | -1 | μA |
| | | $V_{GS} = 5 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 500 | nA |
| | | $V_{GS} = -5 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | -500 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 V$; $I_D = 380 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 1.8 | 2.3 | Ω |
| | | $V_{GS} = 10 V$; $I_D = 380 \text{ mA}$; $T_j = 150 \text{ }^\circ C$ | - | 3.9 | 4.9 | Ω |
| | | $V_{GS} = 5 V$; $I_D = 330 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 2.2 | 2.9 | Ω |
| | | $V_{GS} = 2.5 V$; $I_D = 260 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 2.4 | 4.8 | Ω |
| g_{fs} | forward transconductance | $V_{DS} = 5 V$; $I_D = 380 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 0.7 | - | S |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS} = 30 V$; $I_D = 380 \text{ mA}$; $V_{GS} = 10 V$; $T_j = 25 \text{ }^\circ C$ | - | 0.5 | 0.7 | nC |
| Q_{GS} | gate-source charge | | - | 0.1 | - | nC |
| Q_{GD} | gate-drain charge | | - | 0.1 | - | nC |
| C_{iss} | input capacitance | $V_{DS} = 30 V$; $f = 1 \text{ MHz}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | 20 | - | pF |
| C_{oss} | output capacitance | | - | 3.1 | - | pF |
| C_{rss} | reverse transfer capacitance | | - | 2 | - | pF |
| | | | | | | |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30 V$; $I_D = 380 \text{ mA}$; $V_{GS} = 10 V$; $R_{G(ext)} = 6 \Omega$; $T_j = 25 \text{ }^\circ C$ | - | 7.9 | - | ns |
| t_r | rise time | | - | 8.4 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 12.5 | - | ns |
| t_f | fall time | | - | 5.1 | - | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 380 \text{ mA}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | 0.7 | 1.2 | V |

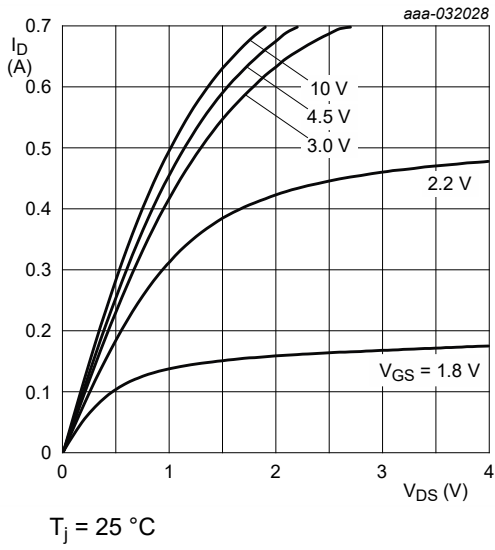


Fig. 7. Output characteristics: drain current as a function of drain-source voltage; typical values

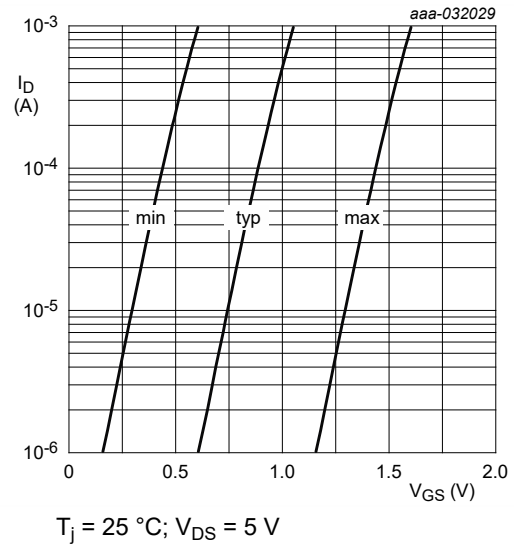


Fig. 8. Sub-threshold drain current as a function of gate-source voltage

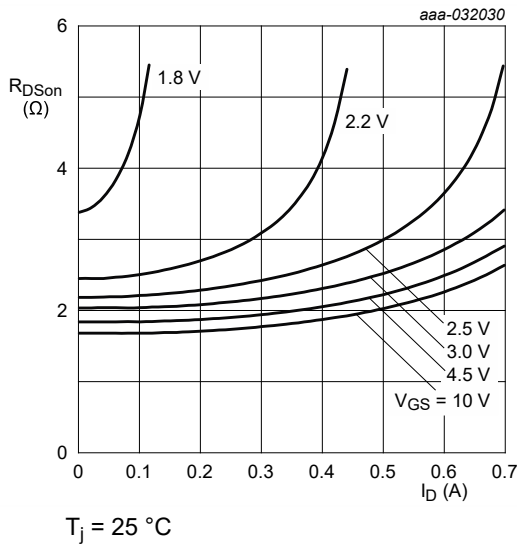


Fig. 9. Drain-source on-state resistance as a function of drain current; typical values

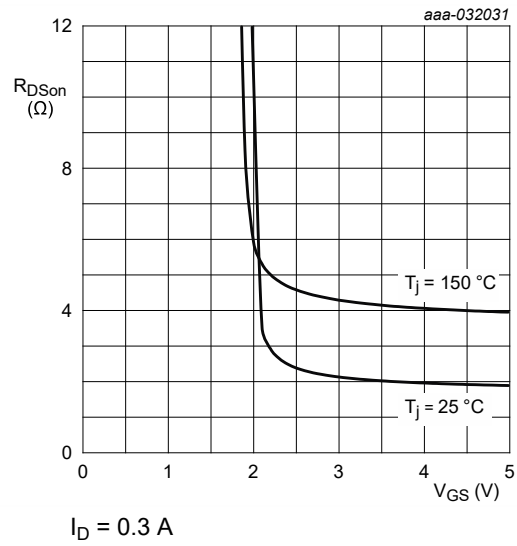


Fig. 10. Drain-source on-state resistance as a function of gate-source voltage; typical values

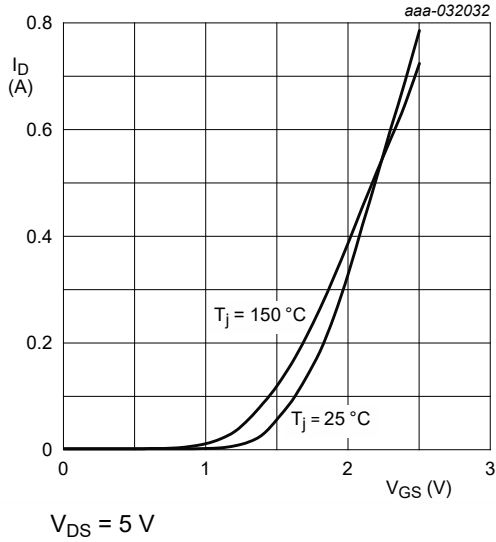


Fig. 11. Transfer characteristics: drain current as a function of gate-source voltage; typical values

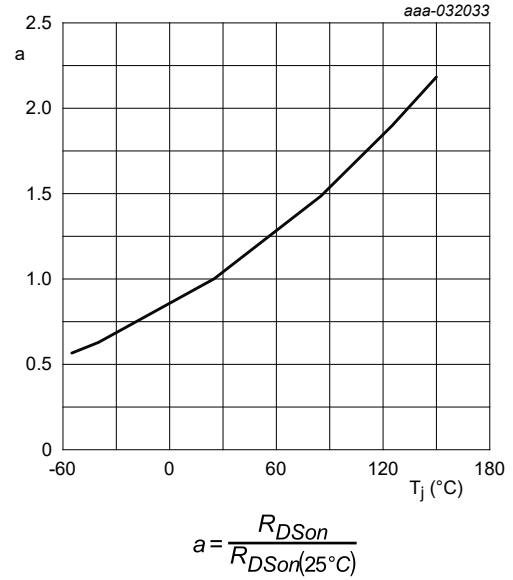


Fig. 12. Normalized drain-source on-state resistance as a function of junction temperature; typical values

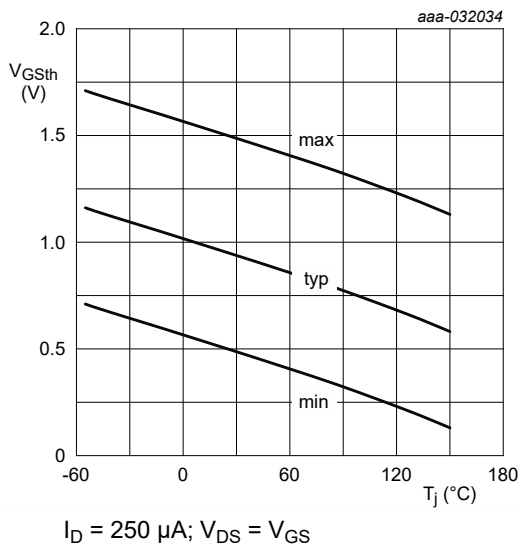


Fig. 13. Gate-source threshold voltage as a function of junction temperature

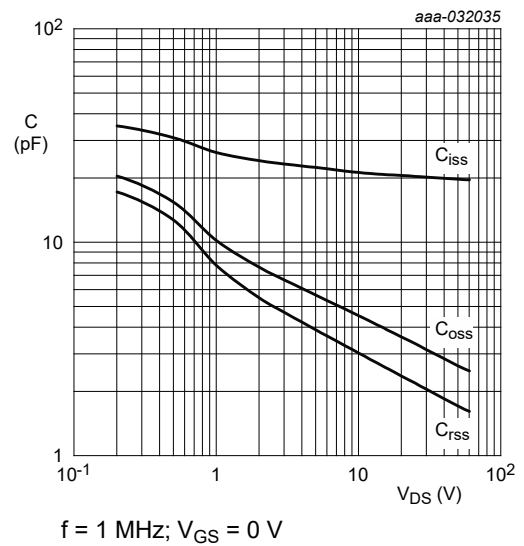
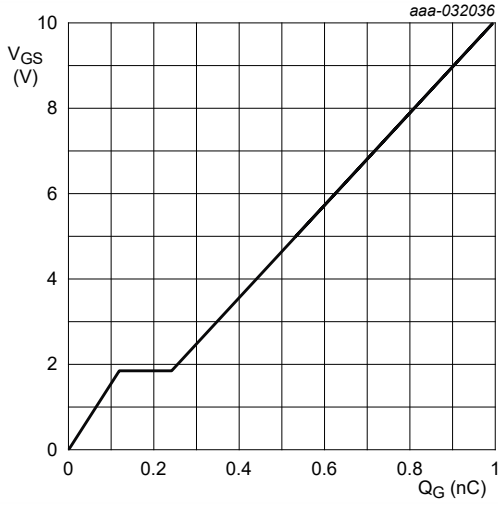


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$

Fig. 15. Gate-source voltage as a function of gate charge; typical values

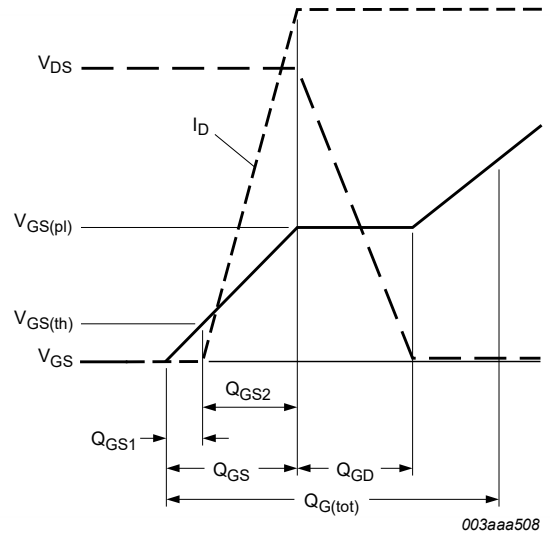
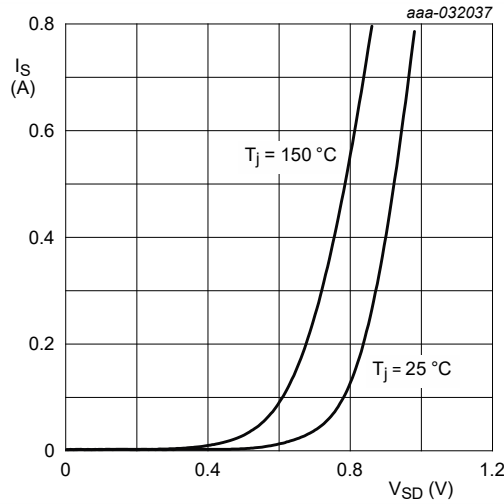


Fig. 16. Gate charge waveform definitions



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

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

11. Test information

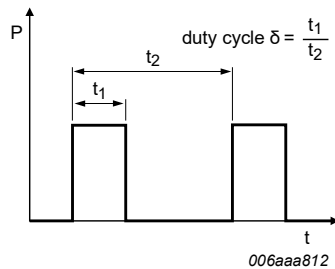


Fig. 18. Duty cycle definition

12. Package outline

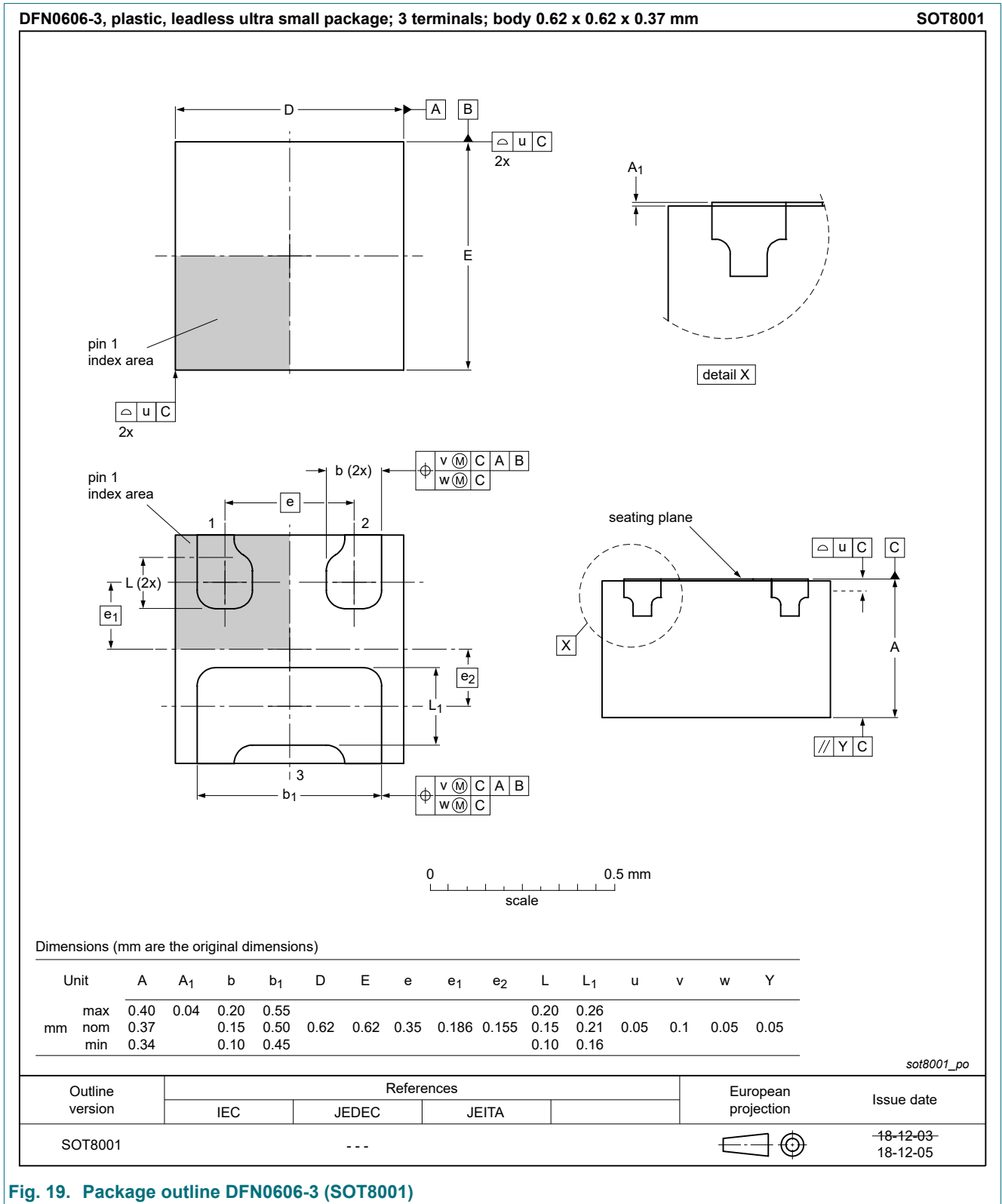


Fig. 19. Package outline DFN0606-3 (SOT8001)

13. Soldering

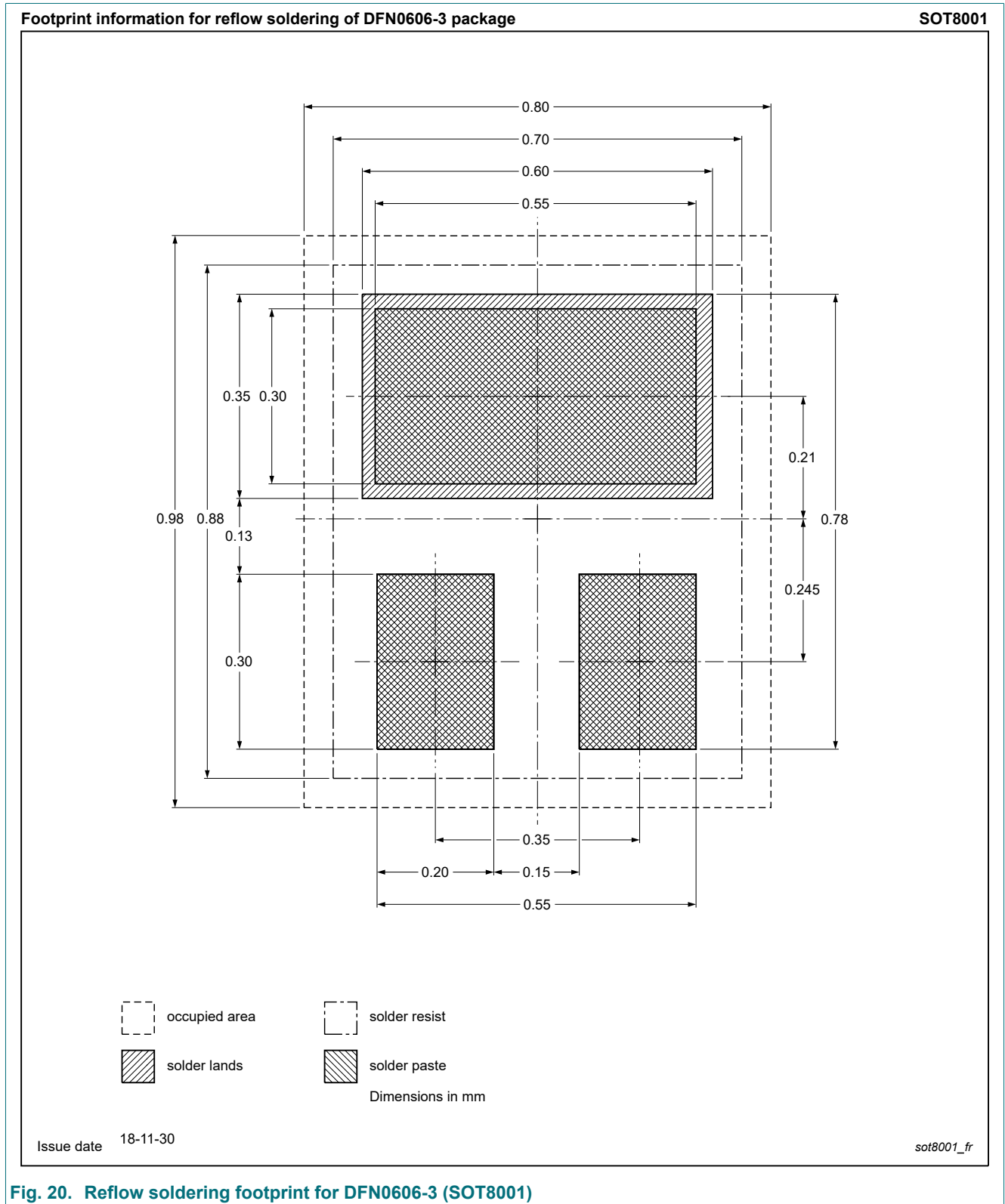


Fig. 20. Reflow soldering footprint for DFN0606-3 (SOT8001)

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| NX138BKH v.1 | 20200901 | 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. |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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