

High-Speed N-Channel Power MOSFET

Features:

- Low Drain-to-Source On Resistance ($R_{DS(ON)}$)
- Low Total Gate Charge (Q_G) and Gate-to-Drain Charge (Q_{GD})
- Low Series Gate Resistance (R_G)
- Fast Switching
- Capable of Short Dead-Time Operation
- RoHS Compliant

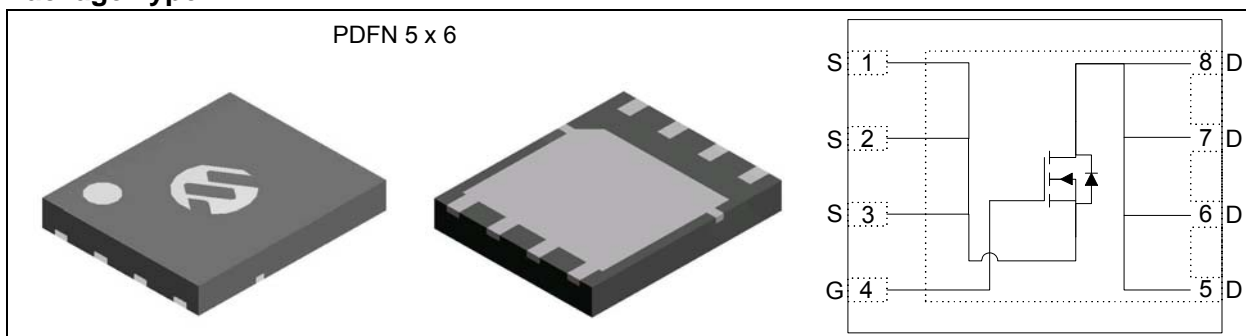
Description:

The MCP87018 is an N-Channel power MOSFET in a popular PDFN 5 mm x 6 mm package. Advanced packaging and silicon processing technologies allow the MCP87018 to achieve a low Q_G for a given $R_{DS(on)}$ value, resulting in a low Figure of Merit (FOM). Combined with low R_G , the low FOM of the MCP87018 allows high-efficiency power conversion with reduced switching and conduction losses.

Applications:

- Point-of-Load DC-DC Converters
- High-Efficiency Power Management in Servers, Networking and Automotive Applications

Package Type



Product Summary Table: Unless otherwise indicated, $T_A = +25^\circ\text{C}$.

| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
|-------------------------------------|-----------------|------|------|------|--------------------|--|
| Operating Characteristics | | | | | | |
| Drain-to-Source Breakdown Voltage | BV_{DSS} | 25 | — | — | V | $V_{GS} = 0V, I_D = 250 \mu A$ |
| Gate-to-Source Threshold Voltage | $V_{GS(TH)}$ | 1 | 1.3 | 1.6 | V | $V_{DS} = V_{GS}, I_D = 250 \mu A$ |
| Drain-to-Source On Resistance | $R_{DS(ON)}$ | — | 1.8 | 2.2 | m Ω | $V_{GS} = 4.5V, I_D = 25A$ |
| | | — | 1.5 | 1.9 | m Ω | $V_{GS} = 10V, I_D = 25A$ |
| Total Gate Charge | Q_G | — | 32.5 | 37 | nC | $V_{DS} = 12.5V, I_D = 25A, V_{GS} = 4.5V$ |
| Gate-to-Drain Charge | Q_{GD} | — | 13 | — | nC | $V_{DS} = 12.5V, I_D = 25A$ |
| Series Gate Resistance | R_G | — | 1.5 | — | Ω | — |
| Thermal Characteristics | | | | | | |
| Thermal Resistance Junction-to-X | $R_{\theta JX}$ | — | — | 55 | $^\circ\text{C/W}$ | Note 1 |
| Thermal Resistance Junction-to-Case | $R_{\theta JC}$ | — | — | 1.0 | $^\circ\text{C/W}$ | Note 2 |

Note 1: $R_{\theta JX}$ is determined with the device surface mounted on a 4-Layer FR4 PCB, with a 1" x 1" mounting pad of 2 oz. copper. This characteristic is dependent on user's board design.

Note 2: $R_{\theta JC}$ is determined using JEDEC 51-14 Method. This characteristic is determined by design.

MCP87018

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

| | |
|---|---------------------------------|
| V_{DS} | +25V |
| V_{GS} | +10.0V / -8V |
| I_D , Continuous | 100A, $T_C = +25^\circ\text{C}$ |
| P_D | 2.2W, $T_A = +25^\circ\text{C}$ |
| T_J , T_{STG} | -55°C to +150°C |
| E_{AS} Avalanche Energy | 612.5 mJ |
| $I_D = 35\text{A}$, $L = 1\text{ mH}$, $R_G = 25\Omega$ | |

† **Notice:** Stresses above those listed under “Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

| Electrical Characteristics: Unless otherwise indicated, $T_A = +25^\circ\text{C}$. | | | | | | |
|---|--------------|------|-------|------|---------------|--|
| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
| Static Characteristics | | | | | | |
| Drain-to-Source Breakdown Voltage | BV_{DSS} | 25 | — | — | V | $V_{GS} = 0\text{V}$, $I_D = 250\ \mu\text{A}$ |
| Drain-to-Source Leakage Current | I_{DSS} | — | — | 1 | μA | $V_{GS} = 0\text{V}$, $V_{DS} = 20\text{V}$ |
| Gate-to-Source Leakage Current | I_{GSS} | — | — | 100 | nA | $V_{DS} = 0\text{V}$, $V_{GS} = 10\text{V}/-8\text{V}$ |
| Gate-to-Source Threshold Voltage | $V_{GS(TH)}$ | 1 | 1.3 | 1.6 | V | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ |
| Drain-to-Source On Resistance | $R_{DS(ON)}$ | — | 2.2 | — | | $V_{GS} = 3.3\text{V}$, $I_D = 25\text{A}$ |
| | | — | 1.8 | 2.2 | m Ω | $V_{GS} = 4.5\text{V}$, $I_D = 25\text{A}$ |
| | | — | 1.5 | 1.9 | m Ω | $V_{GS} = 10\text{V}$, $I_D = 25\text{A}$ |
| Transconductance | g_{fs} | — | 162 | — | S | $V_{DS} = 12.5\text{V}$, $I_D = 25\text{A}$ |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{ISS} | — | 2925 | — | pF | $V_{GS} = 0\text{V}$, $V_{DS} = 12.5\text{V}$, $f = 1\text{ MHz}$ |
| Output Capacitance | C_{OSS} | — | 1305 | — | pF | $V_{GS} = 0\text{V}$, $V_{DS} = 12.5\text{V}$, $f = 1\text{ MHz}$ |
| Reverse Transfer Capacitance | C_{RSS} | — | 330 | — | pF | $V_{GS} = 0\text{V}$, $V_{DS} = 12.5\text{V}$, $f = 1\text{ MHz}$ |
| Total Gate Charge | Q_G | — | 32.5 | 37 | nC | $V_{DS} = 12.5\text{V}$, $I_D = 25\text{A}$, $V_{GS} = 4.5\text{V}$ |
| Gate-to-Drain Charge | Q_{GD} | — | 13 | — | nC | $V_{DS} = 12.5\text{V}$, $I_D = 25\text{A}$ |
| Gate-to-Source Charge | Q_{GS} | — | 5.3 | — | nC | $V_{DS} = 12.5\text{V}$, $I_D = 25\text{A}$ |
| Gate Charge at $V_{GS(TH)}$ | $Q_{G(TH)}$ | — | 3.8 | — | nC | $V_{DS} = 12.5\text{V}$, $I_D = 25\text{A}$ |
| Output Charge | Q_{OSS} | — | 26 | — | nC | $V_{DS} = 12.5\text{V}$, $V_{GS} = 0$ |
| Turn-On Delay Time | $t_{d(on)}$ | — | 6.53 | — | ns | $V_{DS} = 12.5\text{V}$, $V_{GS} = 4.5\text{V}$, $I_D = 25\text{A}$, $R_G = 2\Omega$ |
| Rise Time | t_r | — | 28.3 | — | ns | $V_{DS} = 12.5\text{V}$, $V_{GS} = 4.5\text{V}$, $I_D = 25\text{A}$, $R_G = 2\Omega$ |
| Turn-Off Delay Time | $t_{d(off)}$ | — | 26.35 | — | ns | $V_{DS} = 12.5\text{V}$, $V_{GS} = 4.5\text{V}$, $I_D = 25\text{A}$, $R_G = 2\Omega$ |
| Fall Time | t_f | — | 28.05 | — | ns | $V_{DS} = 12.5\text{V}$, $V_{GS} = 4.5\text{V}$, $I_D = 25\text{A}$, $R_G = 2\Omega$ |
| Series Gate Resistance | R_G | — | 1.5 | — | Ω | |

DC ELECTRICAL CHARACTERISTICS (CONTINUED)

| Electrical Characteristics: Unless otherwise indicated, $T_A = +25^\circ\text{C}$. | | | | | | |
|---|----------|------|------|------|-------|---|
| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
| Diode Characteristics | | | | | | |
| Diode Forward Voltage | V_{FD} | — | 0.8 | 1 | V | $I_S = 25\text{A}$, $V_{GS} = 0\text{V}$ |
| Reverse Recovery Charge | Q_{RR} | — | 47 | — | nC | $I_S = 25\text{A}$, $di/dt = 300\text{ A}/\mu\text{s}$ |
| Reverse Recovery Time | t_{rr} | — | 28 | — | ns | $I_S = 25\text{A}$, $di/dt = 300\text{ A}/\mu\text{s}$ |
| Avalanche Characteristics | | | | | | |
| Avalanche Energy | E_{AS} | 200 | — | — | mJ | $I_D = 20\text{A}$, $L = 1\text{ mH}$, $R_G = 25\Omega$ |

TEMPERATURE CHARACTERISTICS

| Electrical Characteristics: Unless otherwise indicated, $T_A = +25^\circ\text{C}$. | | | | | | |
|---|-----------------|------|------|------|---------------------------|------------------------|
| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
| Temperature Ranges | | | | | | |
| Operating Junction Temperature Range | T_J | -55 | — | 150 | $^\circ\text{C}$ | |
| Storage Temperature Range | T_A | -55 | — | 150 | $^\circ\text{C}$ | |
| Package Thermal Resistances | | | | | | |
| Thermal Resistance Junction-to-X, 8L 5x6-PDFN | $R_{\theta JX}$ | — | — | 55 | $^\circ\text{C}/\text{W}$ | Note 1 |
| Thermal Resistance Junction-to-Case, 8L 5x6-PDFN | $R_{\theta JC}$ | — | — | 1.0 | $^\circ\text{C}/\text{W}$ | Note 2 |

Note 1: $R_{\theta JX}$ is determined with the device surface mounted on a 4-Layer FR4 PCB, with a 1" x 1" mounting pad of 2 oz. copper. This characteristic is dependent on user's board design.

2: $R_{\theta JC}$ is determined using JEDEC 51-14 Method. This characteristic is determined by design.

MCP87018

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$.

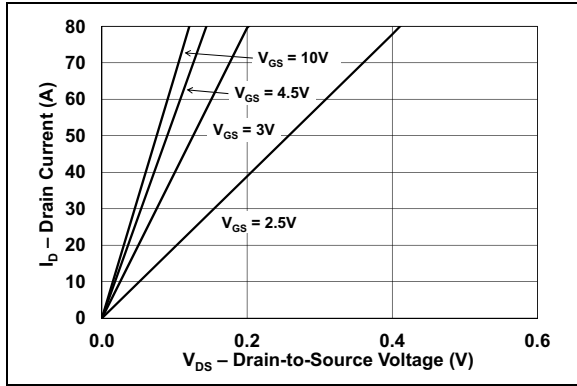


FIGURE 2-1: Typical Output Characteristics.

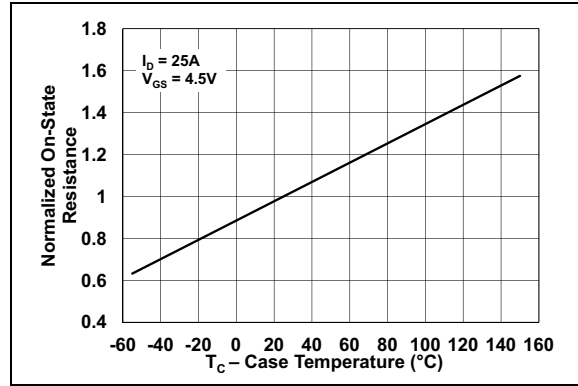


FIGURE 2-4: Normalized On-State Resistance vs. Temperature.

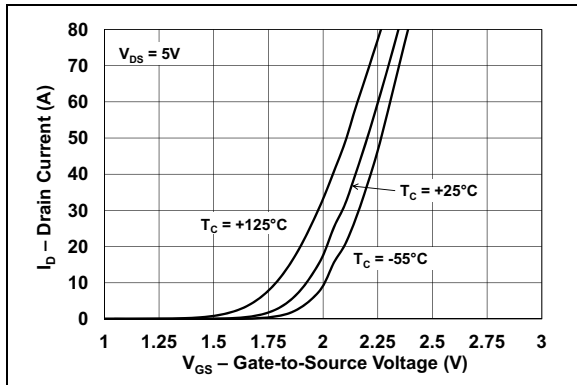


FIGURE 2-2: Typical Transfer Characteristics.

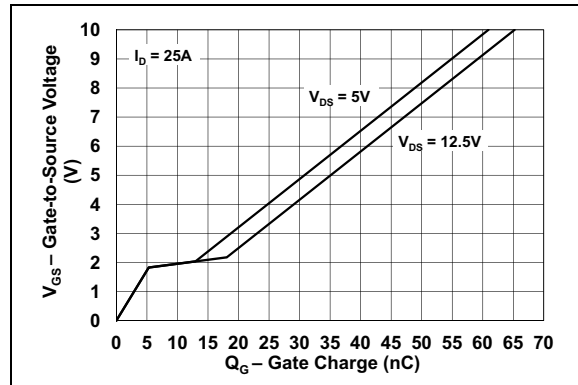


FIGURE 2-5: Gate-to-Source Voltage vs. Gate Charge.

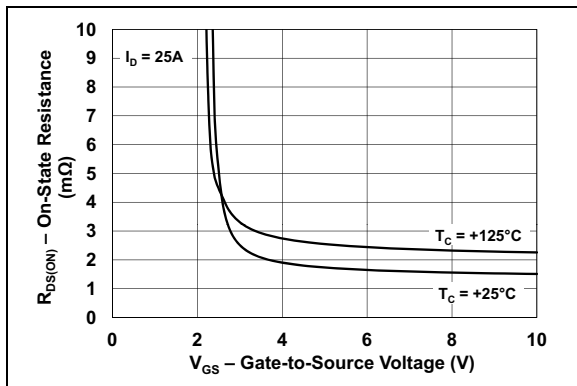


FIGURE 2-3: On-State Resistance vs. Gate-to-Source Voltage.

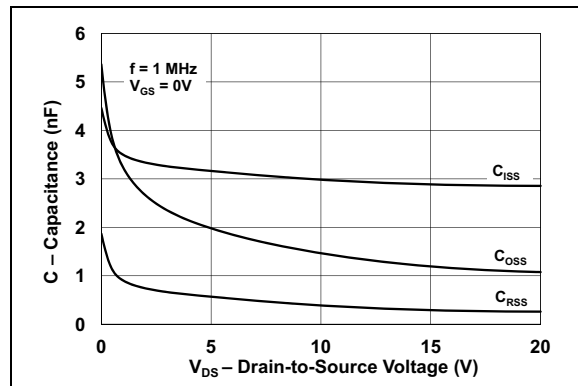


FIGURE 2-6: Capacitance vs. Drain-to-Source Voltage.

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$.

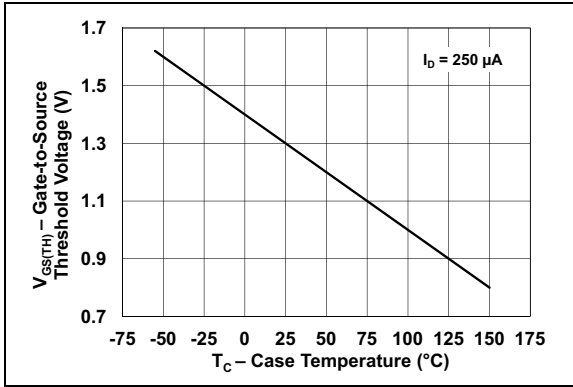


FIGURE 2-7: Gate-to-Source Threshold Voltage vs. Temperature.

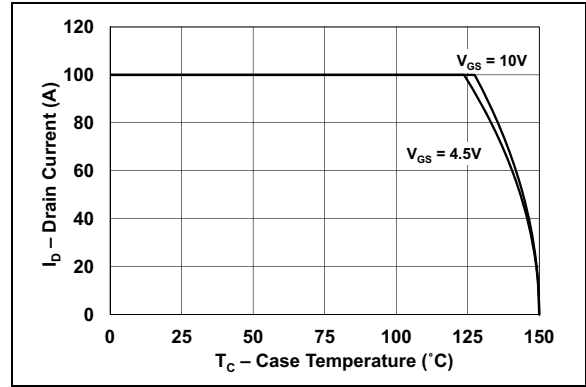


FIGURE 2-10: Maximum Drain Current vs. Temperature.

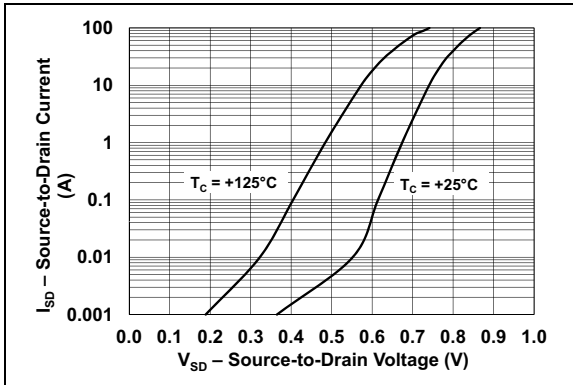


FIGURE 2-8: Source-to-Drain Current vs. Source-to-Drain Voltage.

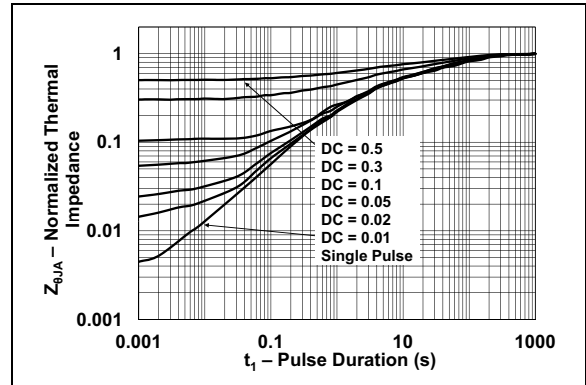


FIGURE 2-11: Transient Thermal Impedance.

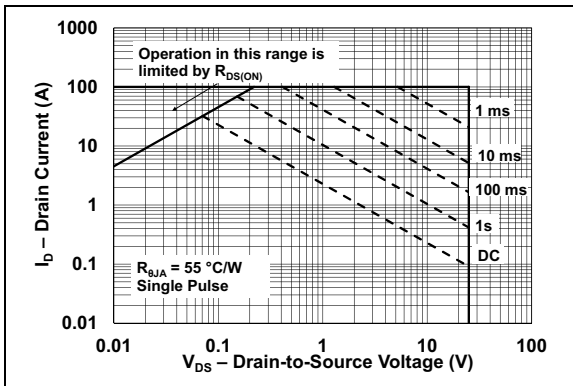


FIGURE 2-9: Maximum Safe Operating Area.

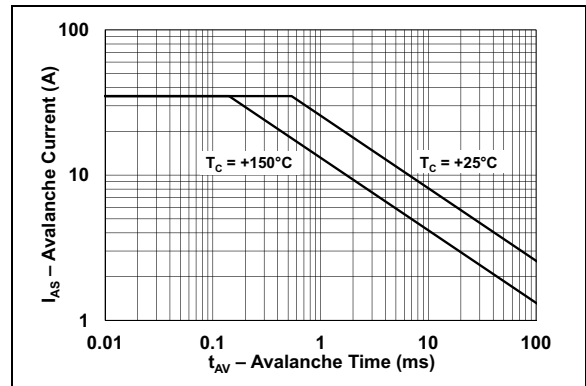


FIGURE 2-12: Single-Pulse Unclamped Inductive Switching.

MCP87018

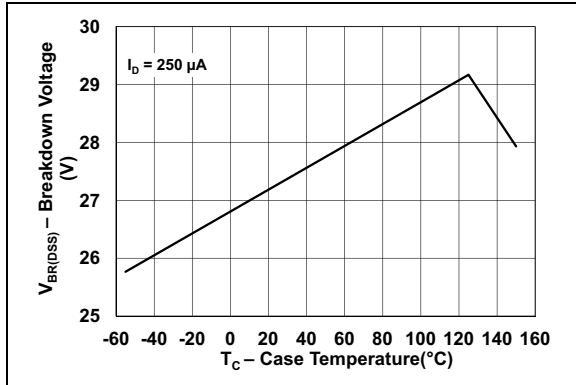


FIGURE 2-13: *Drain-to-Source Breakdown Voltage vs. Temperature.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

TABLE 3-1: PIN FUNCTION TABLE

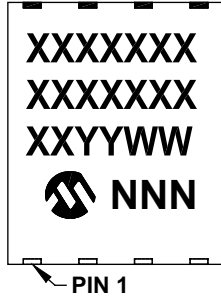
| MCP87018 5x6 PDFN | Symbol | Description |
|-----------------------------|---------------|--|
| 1, 2, 3 | S | Source pin |
| 4 | G | Gate pin |
| 5, 6, 7, 8 | D | Drain pin, including exposed thermal pad |

MCP87018

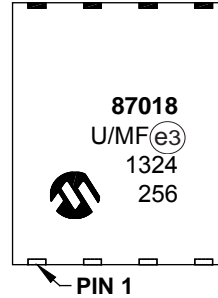
4.0 PACKAGING INFORMATION

4.1 Package Marking Information*

8-Lead PDFN (5x6x1.0 mm)



Example

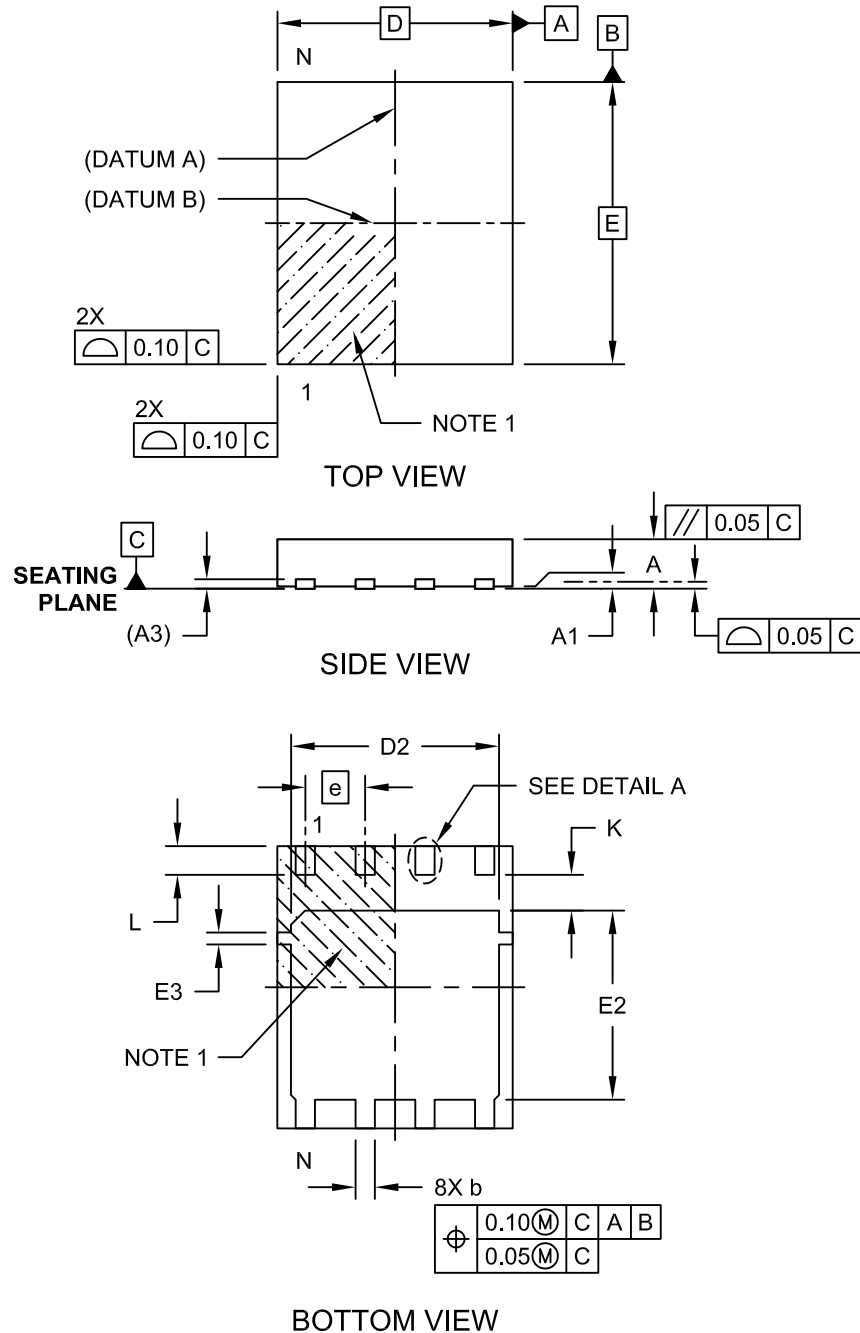


*RoHS compliant using EU-RoHS exemption: 7(a) – Lead in high-melting-temperature-type solders (i.e., lead-based alloys containing 85% by weight or more lead) can be found on the outer packaging for this package.

| | | |
|----------------|---|--|
| Legend: | XX...X | Customer-specific information |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week '01') |
| | NNN | Alphanumeric traceability code |
| | (e3) | Pb-free JEDEC designator for Matte Tin (Sn) |
| | * | This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package. |
| Note: | In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. | |

8-Lead Power Dual Flatpack No Lead Package (MF) – 5x6x1.0 mm Body [PDFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

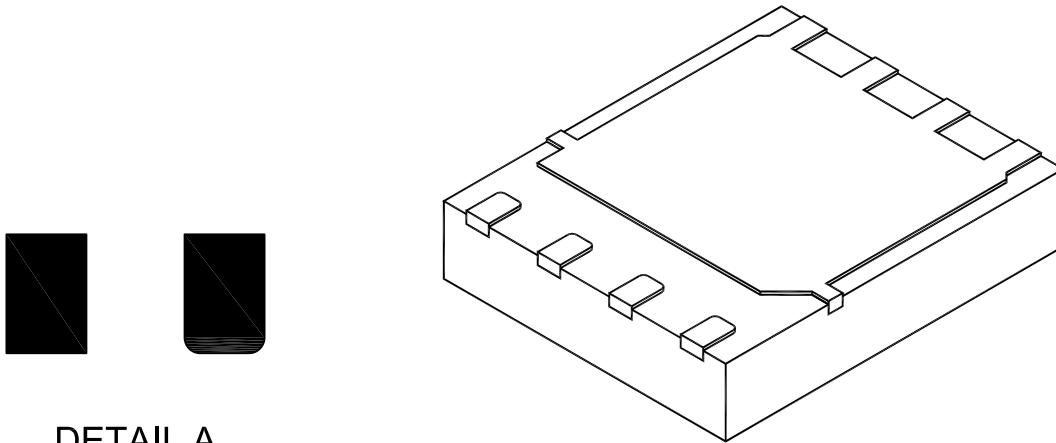


Microchip Technology Drawing C04-188B Sheet 1 of 2

MCP87018

8-Lead Power Dual Flatpack No Lead Package (MF) – 5x6x1.0 mm Body [PDFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



DETAIL A

ALTERNATE
CONTACT
SHAPES

| Dimension | Units Limits | MILLIMETERS | | |
|-------------------------|-----------------|-------------|------|------|
| | | MIN | NOM | MAX |
| Number of Pins | N | 8 | | |
| Pitch | e | 1.27 BSC | | |
| Overall Height | A | 0.80 | 1.00 | 1.03 |
| Standoff | A1 | 0.00 | - | 0.05 |
| Terminal Thickness | (A3) | 0.20 REF | | |
| Overall Length | D | 5.00 BSC | | |
| Overall Width | E | 6.00 BSC | | |
| Exposed Pad length | D2 | 4.27 | 4.42 | 4.52 |
| Exposed Pad Width | E2 | 3.87 | 4.02 | 4.12 |
| Tab Width | E3 | 0.20 | 0.25 | 0.30 |
| Terminal Width | b | 0.36 | 0.41 | 0.46 |
| Terminal Length | L | 0.51 | 0.61 | 0.71 |
| Terminal to Exposed Pad | K | 0.71 | 0.76 | 0.81 |

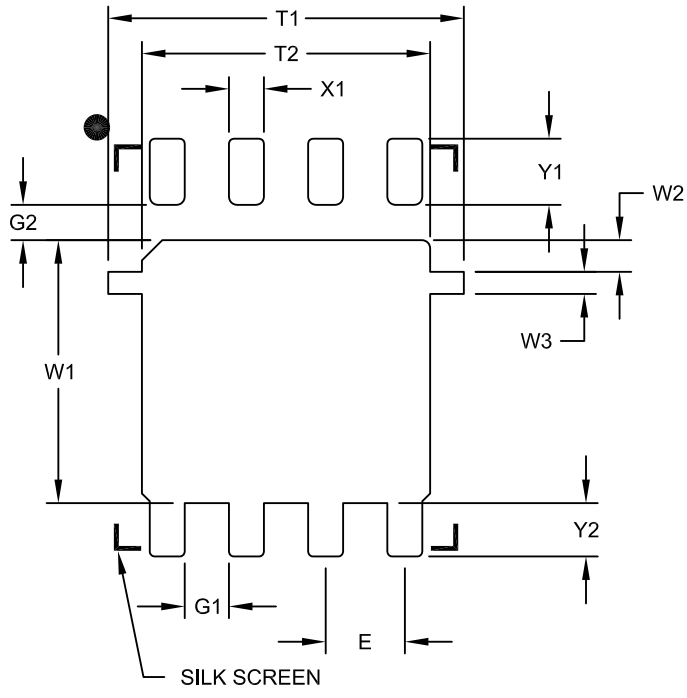
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated.
3. Package dimension does not include mold flash, protrusions, burrs or metal smearing.
4. Dimensioning and tolerancing per ASME Y14.5M.
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-188B Sheet 2 of 2

8-Lead Power Dual Flatpack No Lead Package (MF) – 5x6x1.0 mm Body [PDFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

| Dimension Limits | Units | MILLIMETERS | | |
|-----------------------------|-------|-------------|------|------|
| | | MIN | NOM | MAX |
| Contact Pitch | E | 1.27 BSC | | |
| Center Pad Width | W1 | | | 4.22 |
| Pad Edge to Tab | W2 | | 0.51 | |
| Tab Width | W3 | | 0.35 | |
| Center Pad Length With Tabs | T1 | | | 5.70 |
| Center Pad Length | T2 | | | 4.62 |
| Distance Between Terminals | G1 | 0.71 | | |
| Terminal To Center Pad (X4) | G2 | 0.57 | | |
| Terminal Pad Width (X8) | X1 | | | 0.56 |
| Terminal Pad Length (X4) | Y1 | | | 1.06 |
| Terminal Pad Length (X8) | Y2 | | | 0.86 |

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2188A

MCP87018

NOTES:

APPENDIX A: REVISION HISTORY

Revision B (July 2013)

The following is the list of modifications:

1. Updated the thermal resistance junction-to-X and junction-to-case values in [Product Summary Table](#) and [Temperature Characteristics](#).
2. Added [Figures 2-9](#) and [2-11](#) in [Section 2.0, Typical Performance Curves](#).
3. Updated [Figure 2-10](#) in [Section 2.0, Typical Performance Curves](#).

Revision A (January 2013)

- Original Release of this Document.

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| <u>PART NO.</u> | <u>X</u> | <u>/XX</u> |
|---------------------------|-------------------|---|
| Device | Temperature Range | Package |
| Device: | MCP87018T: | N-Channel Power MOSFET (Tape and Reel) |
| Temperature Range: | U | = -55°C to +150°C (Ultra High) |
| Package: | MF | = 8-Lead High Power Dual Flatpack, No Lead Package (5x6x1.0 mm Body) (PDFN), 8-lead |

Examples:

a) MCP87018T-U/MF: Tape and Reel, Ultra High Temperature, 8LD PDFN package

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