

# MOSFET – Power, Dual, N-Channel, for 1-2 Cells Lithium-ion Battery Protection

20 V, 4.7 mΩ, 23 A

## EFC3J018NUZ

### Introduction

This Power MOSFET features a low on-state resistance. This device is suitable for applications such as power switches of portable machines. Best suited for 1–2 cells lithium-ion battery applications.

### Features

- 2.5 V Drive
- 2 kV ESD HBM
- Common-Drain Type
- ESD Diode-Protected Gate
- This Device is Pb-Free and Halide Free

### Applications

- 1-2 Cells Lithium-ion Battery Charging and Discharging Switch

### Specifications

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

| Parameter                                                                   | Symbol        | Value           | Unit             |
|-----------------------------------------------------------------------------|---------------|-----------------|------------------|
| Source to Source Voltage                                                    | $V_{SSS}$     | 20              | V                |
| Gate to Source Voltage                                                      | $V_{GSS}$     | $\pm 12$        | V                |
| Maximum Operating Gate to Source Voltage (Note 1)                           | $V_{GSS(OP)}$ | $\pm 8$         | V                |
| Source Current (DC)                                                         | $I_S$         | 23              | A                |
| Source Current (Pulse)<br>PW $\leq 100 \mu\text{s}$ , duty cycle $\leq 1\%$ | $I_{SP}$      | 100             | A                |
| Total Dissipation (Note 2)                                                  | $P_T$         | 2.5             | W                |
| Junction Temperature                                                        | $T_j$         | 150             | $^\circ\text{C}$ |
| Storage Temperature                                                         | $T_{stg}$     | $-55$ to $+150$ | $^\circ\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- Functional operation above the stresses listed in the recommended operating ranges is not implied. Extended exposure to stresses beyond the recommended operating ranges limits may affect device reliability.

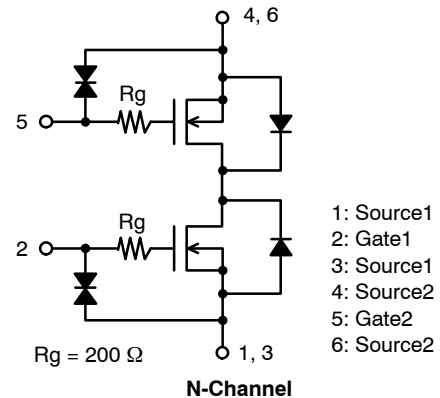
#### THERMAL RESISTANCE RATINGS

| Parameter                    | Symbol          | Value | Unit               |
|------------------------------|-----------------|-------|--------------------|
| Junction to Ambient (Note 2) | $R_{\theta JA}$ | 50    | $^\circ\text{C/W}$ |

- Surface mounted on ceramic substrate ( $5000 \text{ mm}^2 \times 0.8 \text{ mm}$ ).

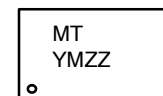
| $V_{SSS}$ | $R_{SS(ON)} \text{ MAX}$ | $I_S \text{ MAX}$ |
|-----------|--------------------------|-------------------|
| 20 V      | 4.7 mΩ @ 4.5 V           | 23 A              |
|           | 4.75 mΩ @ 4.0 V          |                   |
|           | 4.9 mΩ @ 3.8 V           |                   |
|           | 5.4 mΩ @ 3.1 V           |                   |
|           | 9.0 mΩ @ 2.5 V           |                   |

### ELECTRICAL CONNECTION



WLCSP6, 1.77 × 3.05  
CASE 567KS

### MARKING DIAGRAM



MT = Specific Device Code  
Y = Year  
M = Month  
ZZ = Assembly Lot Number

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

# EFC3J018NUZ

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C) (Note 3)

| Parameter                                   | Symbol               | Conditions                                                                        | Min  | Typ  | Max  | Unit |
|---------------------------------------------|----------------------|-----------------------------------------------------------------------------------|------|------|------|------|
| Source to Source Breakdown Voltage          | V <sub>(BR)SSS</sub> | I <sub>S</sub> = 1 mA, V <sub>GS</sub> = 0 V (Figure 1)                           | 20   | –    | –    | V    |
| Zero-Gate Voltage Source Current            | I <sub>SSS</sub>     | V <sub>SS</sub> = 20 V, V <sub>GS</sub> = 0 V (Figure 1)                          | –    | –    | 1    | μA   |
| Gate to Source Leakage Current              | I <sub>GSS</sub>     | V <sub>GS</sub> = ±8 V, V <sub>SS</sub> = 0 V (Figure 2)                          | –    | –    | ±1   | μA   |
| Gate Threshold Voltage                      | V <sub>GS(th)</sub>  | V <sub>SS</sub> = 10 V, I <sub>S</sub> = 1 mA (Figure 3)                          | 0.5  | –    | 1.3  | V    |
| Static Source to Source On-State Resistance | R <sub>SS(on)</sub>  | I <sub>S</sub> = 5 A, V <sub>GS</sub> = 4.5 V (Figure 4)                          | 2.5  | 3.6  | 4.7  | mΩ   |
|                                             |                      | I <sub>S</sub> = 5 A, V <sub>GS</sub> = 4.0 V (Figure 4)                          | 2.56 | 3.65 | 4.75 | mΩ   |
|                                             |                      | I <sub>S</sub> = 5 A, V <sub>GS</sub> = 3.8 V (Figure 4)                          | 2.6  | 3.75 | 4.9  | mΩ   |
|                                             |                      | I <sub>S</sub> = 5 A, V <sub>GS</sub> = 3.1 V (Figure 4)                          | 2.9  | 4.15 | 5.4  | mΩ   |
|                                             |                      | I <sub>S</sub> = 5 A, V <sub>GS</sub> = 2.5 V (Figure 4)                          | 3.3  | 4.75 | 9.0  | mΩ   |
| Turn-ON Delay Time                          | t <sub>d(on)</sub>   | V <sub>SS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>S</sub> = 3 A (Figure 5)  | –    | 280  | –    | ns   |
| Rise Time                                   | t <sub>r</sub>       |                                                                                   | –    | 890  | –    | ns   |
| Turn-OFF Delay Time                         | t <sub>d(off)</sub>  |                                                                                   | –    | 4100 | –    | ns   |
| Fall Time                                   | t <sub>f</sub>       |                                                                                   | –    | 2800 | –    | ns   |
| Total Gate Charge                           | Q <sub>g</sub>       | V <sub>SS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>S</sub> = 23 A (Figure 6) | –    | 75   | –    | nC   |
| Forward Source to Source Voltage            | V <sub>F(S-S)</sub>  | I <sub>S</sub> = 3 A, V <sub>GS</sub> = 0 V (Figure 7)                            | –    | 0.74 | 1.2  | V    |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Refer to the JIS 7030 measuring methods for transistors for measuring.

Test Circuits are Example of Measuring FET1 Side

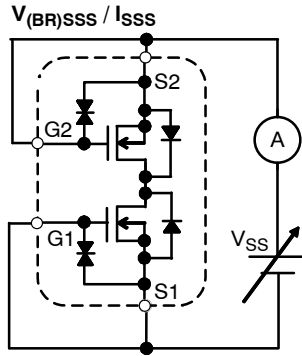


Figure 1. Test Circuit 1

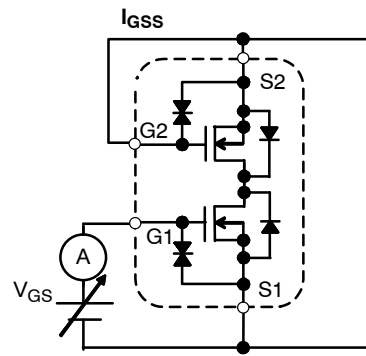


Figure 2. Test Circuit 2

When FET1 is measured, Gate and Source of FET2 are short-circuited.

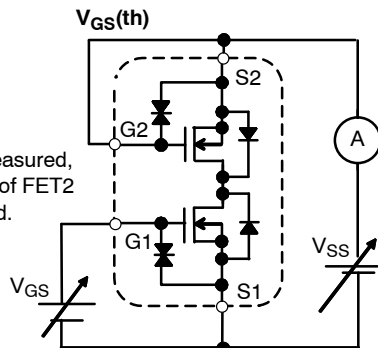


Figure 3. Test Circuit 3

When FET1 is measured, Gate and Source of FET2 are short-circuited.

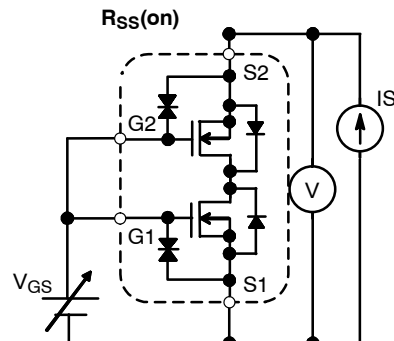


Figure 4. Test Circuit 4

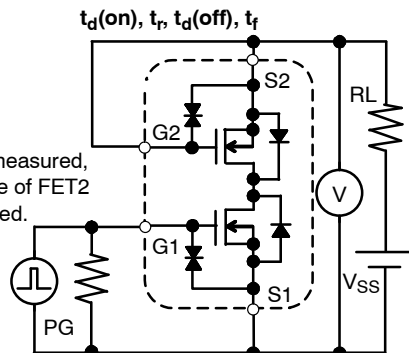


Figure 5. Test Circuit 5

When FET1 is measured, Gate and Source of FET2 are short-circuited.

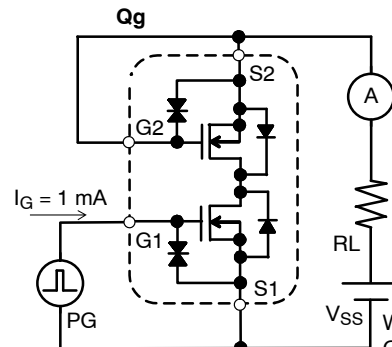


Figure 6. Test Circuit 6

When FET1 is measured, Gate and Source of FET2 are short-circuited.

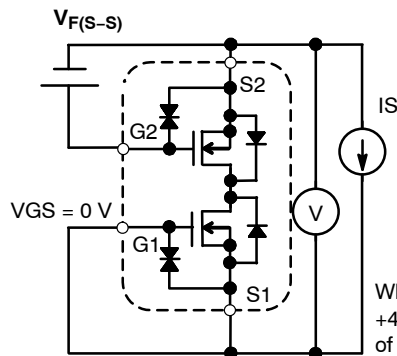


Figure 7. Test Circuit 7

When FET1 is measured, +4.5 V is added to VGS of FET2.

NOTE: When FET2 is measured, the position of FET1 and FET2 is switched.

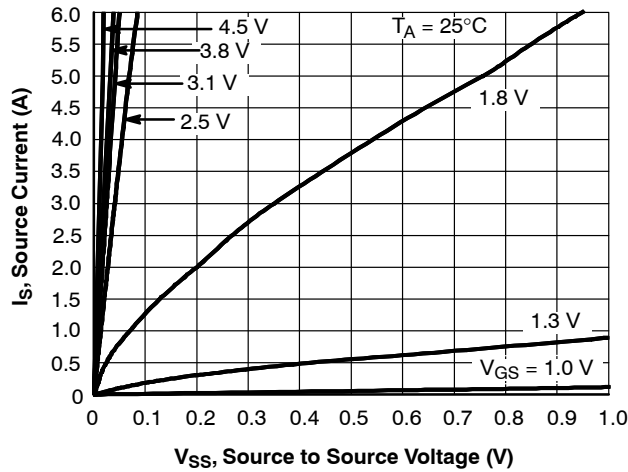


Figure 8.  $I_S - V_{SS}$

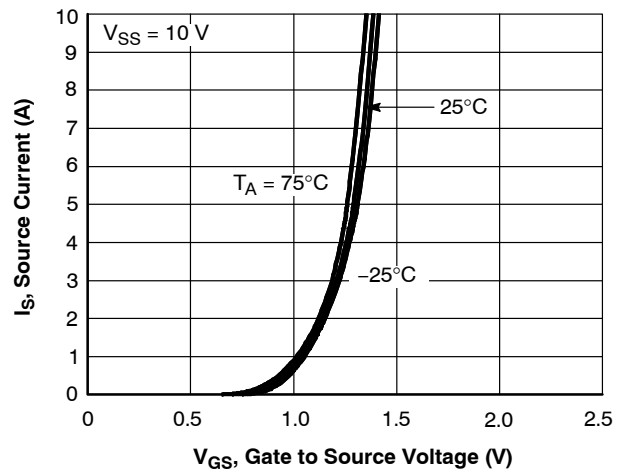


Figure 9.  $I_S - V_{GS}$

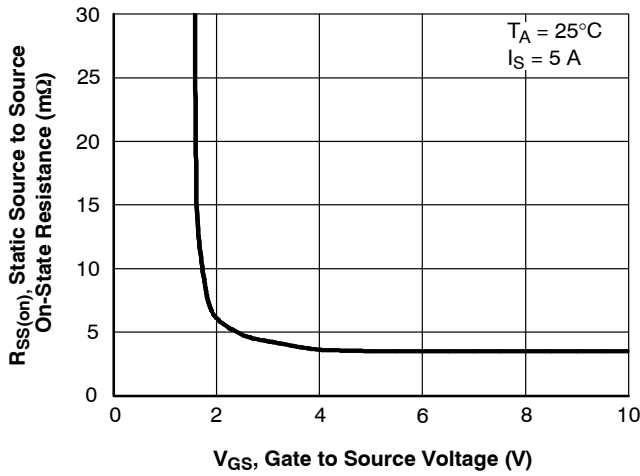


Figure 10.  $R_{SS(on)} - V_{GS}$

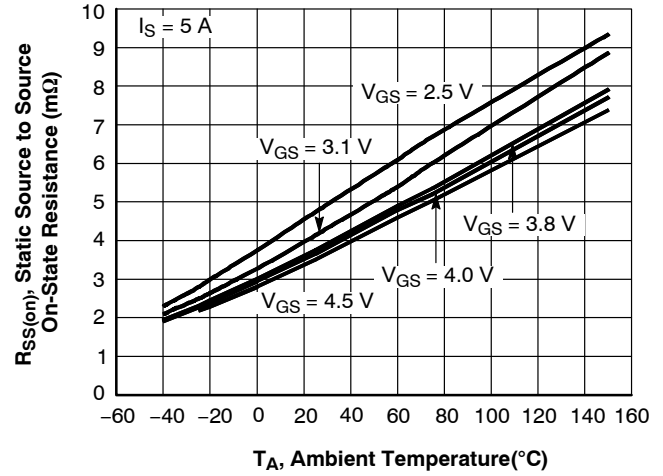


Figure 11.  $R_{SS(on)} - T_A$

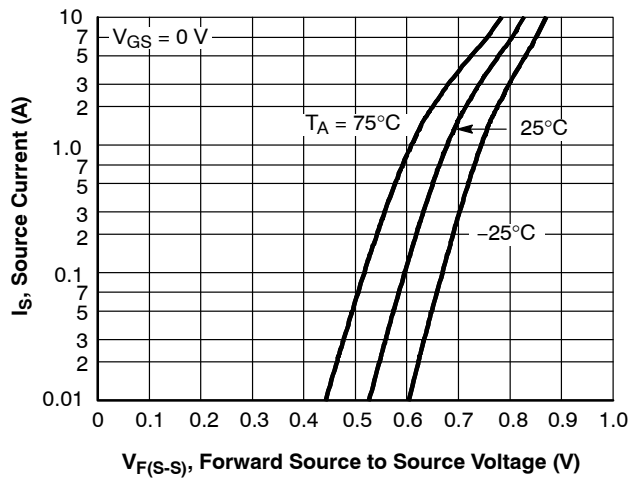


Figure 12.  $I_S - V_{F(S-S)}$

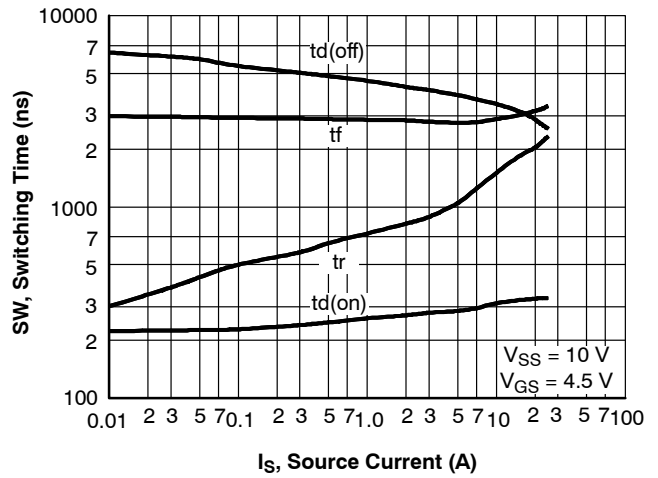


Figure 13. SW Time -  $I_S$

# EFC3J018NUZ

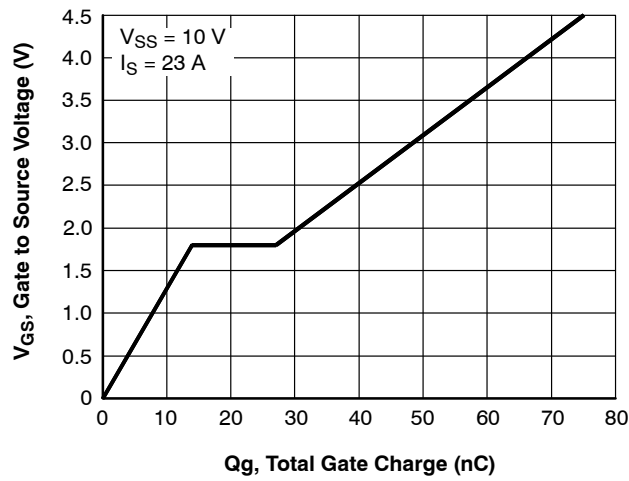


Figure 14.  $V_{GS} - Q_g$

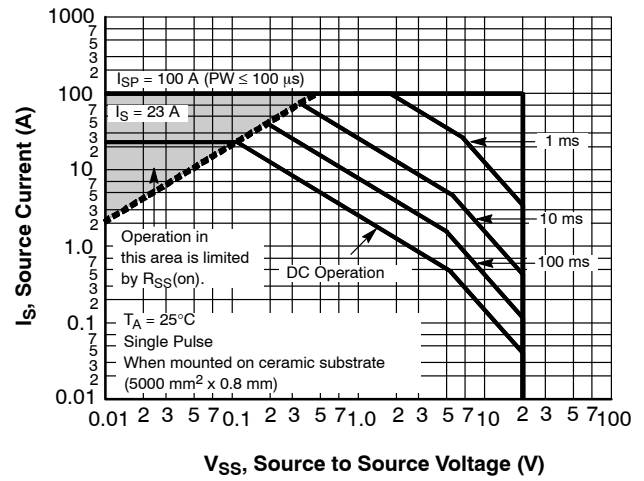


Figure 15. SOA

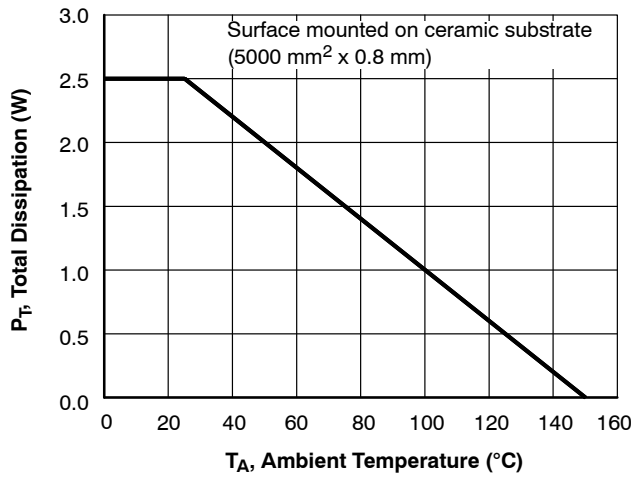


Figure 16.  $P_T - T_a$

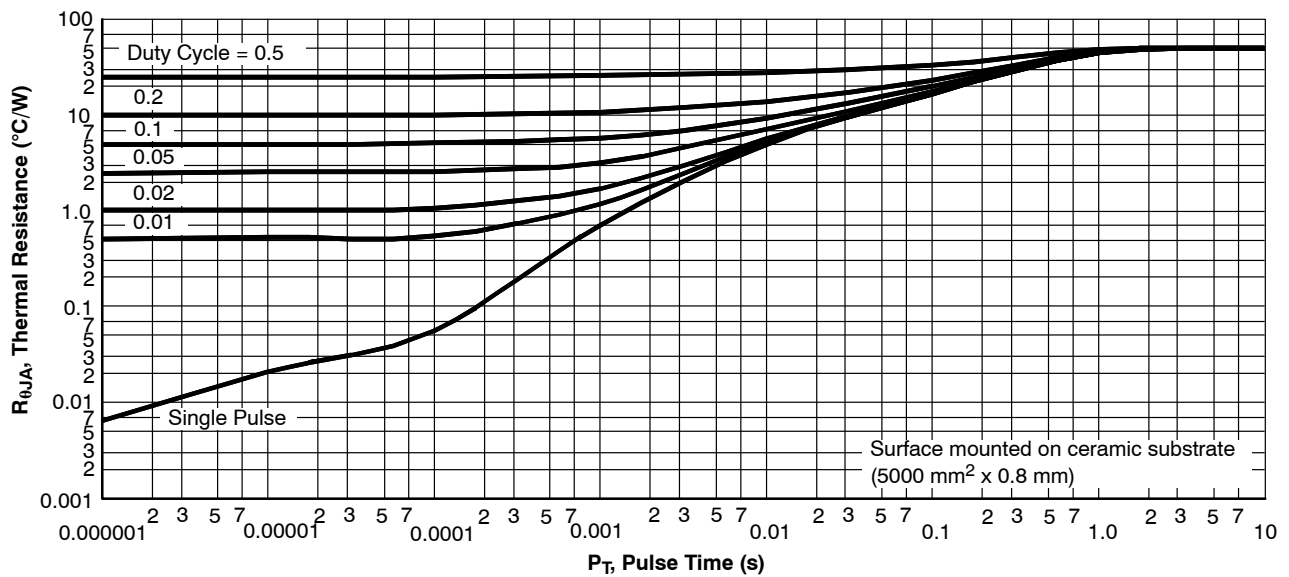


Figure 17.  $R_{\theta JA} - \text{Pulse Time}$

## EFC3J018NUZ

### ORDERING INFORMATION

| Device         | Marking | Package                                        | Shipping <sup>†</sup> (Qty / Packing) |
|----------------|---------|------------------------------------------------|---------------------------------------|
| EFC3J018NUZTDG | MT      | WLCSP6, 1.77 × 3.05<br>(Pb-Free / Halide Free) | 5000 / Tape & Reel                    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

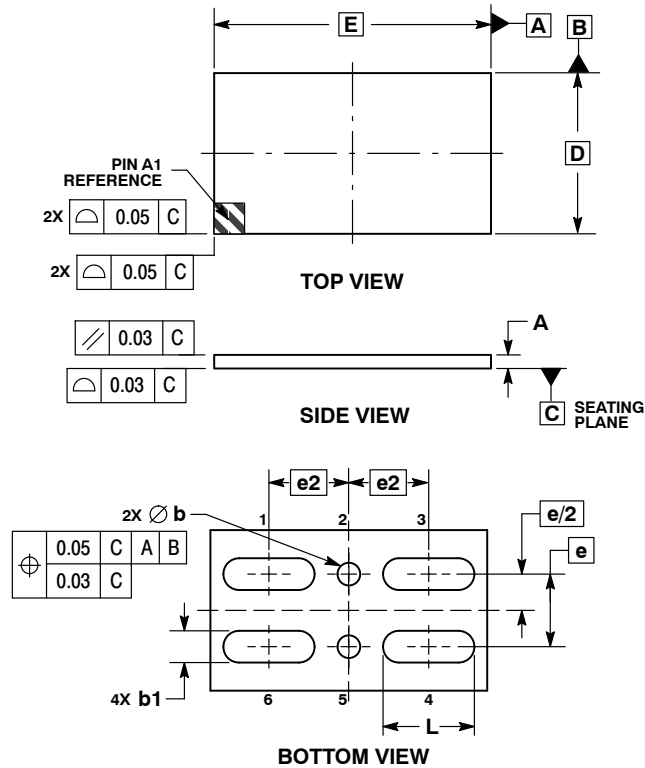
Note on usage: Since the EFC3J018NUZ is a MOSFET product, please avoid using this device in the vicinity of highly charged objects. Please contact sales for use except the designated application.



SCALE 4:1

**WLCSP6, 1.77x3.05**  
**CASE 567KS**  
**ISSUE O**

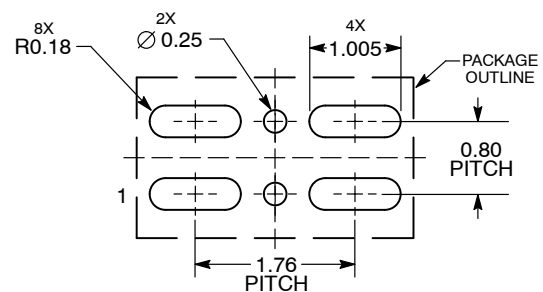
DATE 29 OCT 2014



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | ---         | 0.145 |
| b   | 0.22        | 0.28  |
| b1  | 0.32        | 0.38  |
| D   | 1.77        | BSC   |
| E   | 3.05        | BSC   |
| e   | 0.80        | BSC   |
| e2  | 0.8775      | BSC   |
| L   | 0.975       | 1.035 |

**RECOMMENDED SOLDERING FOOTPRINT\***


DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

|                         |                          |                                                                                                                                                                                     |
|-------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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