

# EFC4C012NL

## Power MOSFET for 3-Cells Lithium-ion Battery Protection 30 V, 6.5 mΩ, 19 A, Dual N-Channel, WLCSP6

This N-Channel Power MOSFET is produced using ON Semiconductor's trench technology, which is specifically designed to minimize gate charge and ultra low on resistance.

This device is suitable for applications of Notebook PC.

### Features

- Ultra Low On-Resistance
- Low Gate Charge
- Common-Drain type
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- 3-Cells Lithium-ion Battery Charging and Discharging Switch

### SPECIFICATIONS

#### ABSOLUTE MAXIMUM RATINGS at $T_A = 25^\circ\text{C}$ (Note 1)

Parameter	Symbol	Value	Unit
Source to Source Voltage	$V_{SSS}$	30	V
Gate to Source Voltage	$V_{GSS}$	$\pm 20$	V
Source Current (DC)	$I_S$	19	A
Source Current (Pulse) $PW \leq 10 \mu\text{s}$ , duty cycle $\leq 1\%$	$I_{SP}$	76	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.

#### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Value	Unit
Junction to Ambient (Note 1)	$R_{\theta JA}$	50	$^\circ\text{C}/\text{W}$

1. Surface mounted on ceramic substrate(5000 mm<sup>2</sup> × 0.8 mm).

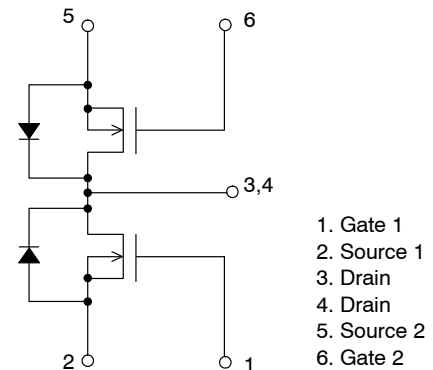


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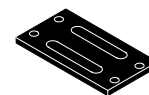
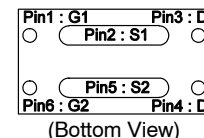
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$V_{SSS}$	$R_{SS(on)}$ Max	$I_S$ Max
30 V	6.5 mΩ @ 10 V	19 A
	8.4 mΩ @ 8 V	
	13 mΩ @ 4.5 V	

### ELECTRICAL CONNECTION N-CHANNEL

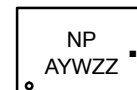


### PIN ASSIGNMENT



WLCSP6  
CASE 567SZ

### MARKING DIAGRAM



- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Assembly Lot
- = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

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## ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$ (Note 1)

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Source to Source Breakdown Voltage	$V_{(BR)SSS}$	$I_S = 1\text{ mA}, V_{GS} = 0\text{ V}$	30			V
Zero-Gate Voltage Source Current	$I_{SSS}$	$V_{SS} = 24\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = 20\text{ V}, V_{SS} = 0\text{ V}$			200	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{SS} = 10\text{ V}, I_S = 1\text{ mA}$	1.3		2.2	V
Static Source to Source On-State Resistance	$R_{SS(on)}$	$V_{GS} = 10\text{ V}, I_S = 5\text{ A}$	3.7	5.0	6.5	$\text{m}\Omega$
		$V_{GS} = 8\text{ V}, I_S = 5\text{ A}$	4.0	5.3	8.4	$\text{m}\Omega$
		$V_{GS} = 4.5\text{ V}, I_S = 5\text{ A}$	5.5	7.3	13	$\text{m}\Omega$
Turn-ON Delay Time	$t_d(on)$	$V_{SS} = 15\text{ V}, V_{GS} = 10\text{ V}$ $I_S = 5\text{ A}, R_g = 5\text{ k}\Omega$ Switching Test Circuit		2.7		$\mu\text{s}$
Rise Time	$t_r$			2.0		$\mu\text{s}$
Turn-OFF Delay Time	$t_d(off)$			26		$\mu\text{s}$
Fall Time	$t_f$			5.7		$\mu\text{s}$
Total Gate Charge	Qg		$V_{SS} = 15\text{ V}, V_{GS} = 4.5\text{ V}$ $I_S = 5\text{ A}$		18	
Forward Source to Source Voltage	$V_{F(S-S)}$	$I_S = 5\text{ A}, V_{GS} = 0\text{ V}, \text{Power Time} = 1\text{ ms}$		0.75	1.2	V

2. 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.

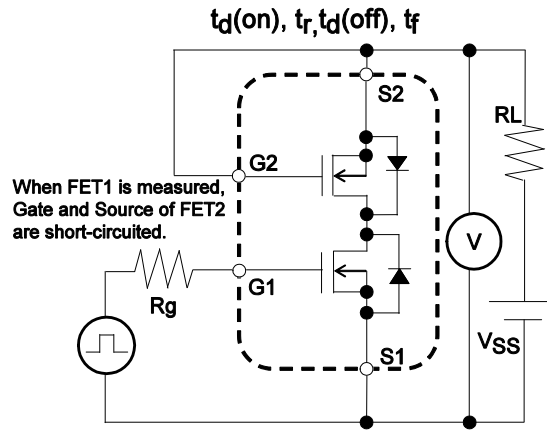


Figure 1. Switching Test Circuit

TYPICAL CHARACTERISTICS

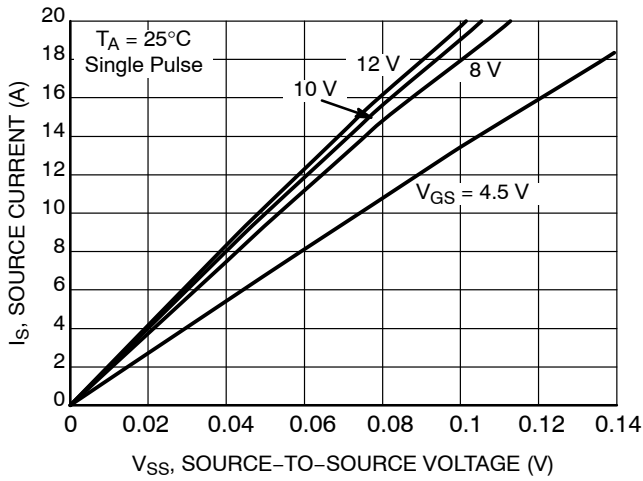


Figure 2. On-Region Characteristics

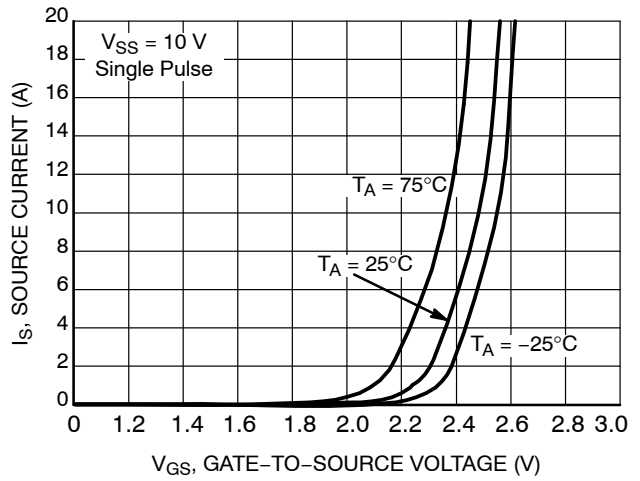


Figure 3. Transfer Characteristics

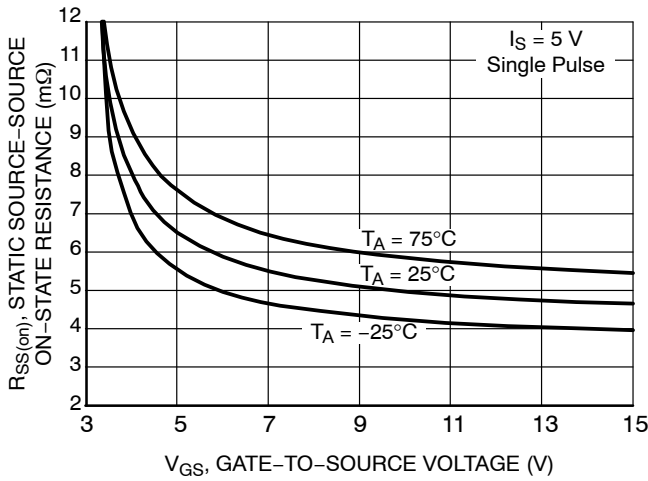


Figure 4. On-Resistance vs. Gate-to-Source Voltage

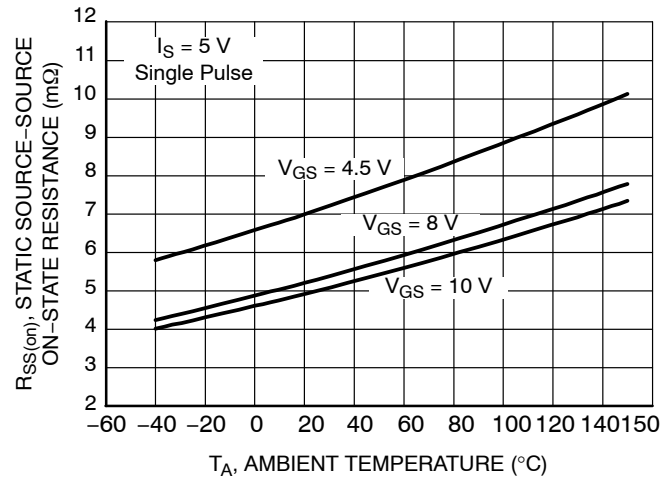


Figure 5. On-Resistance vs. Temperature

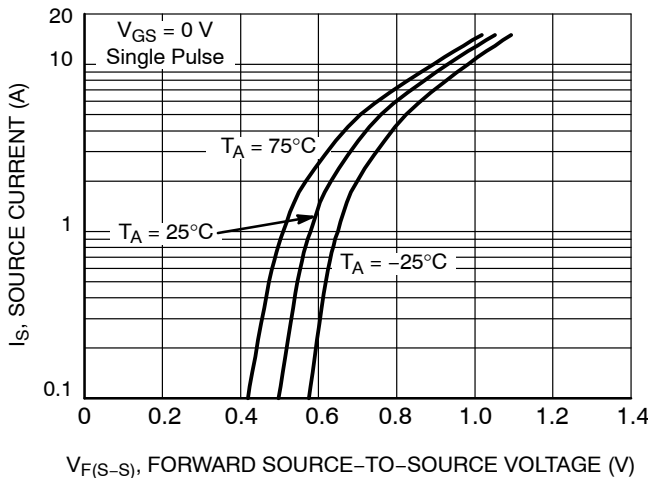


Figure 6. Forward Source-to-Source Voltage vs. Current

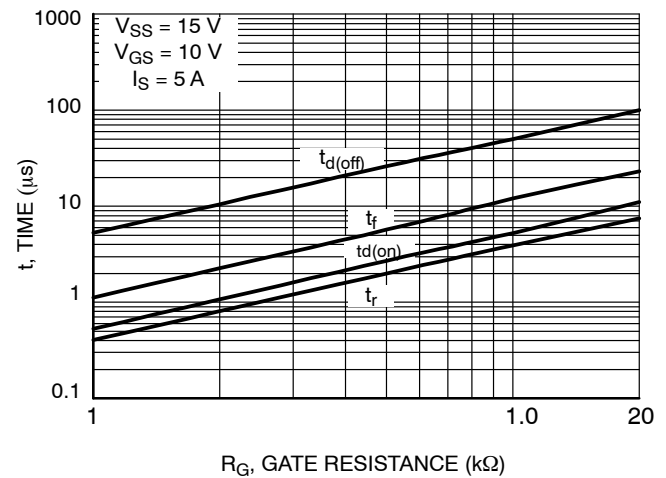
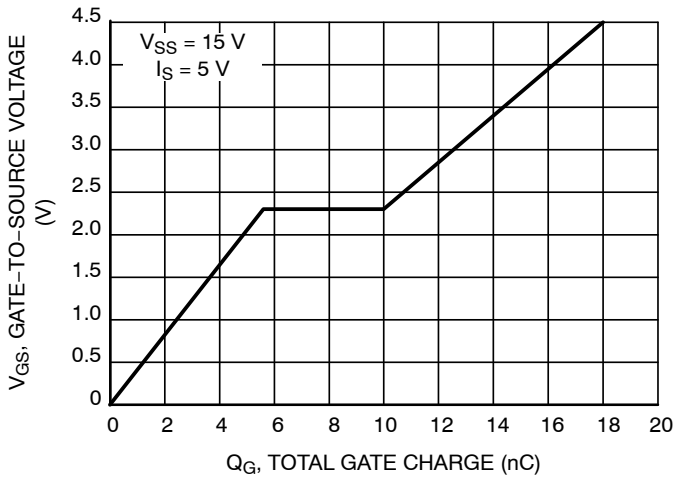
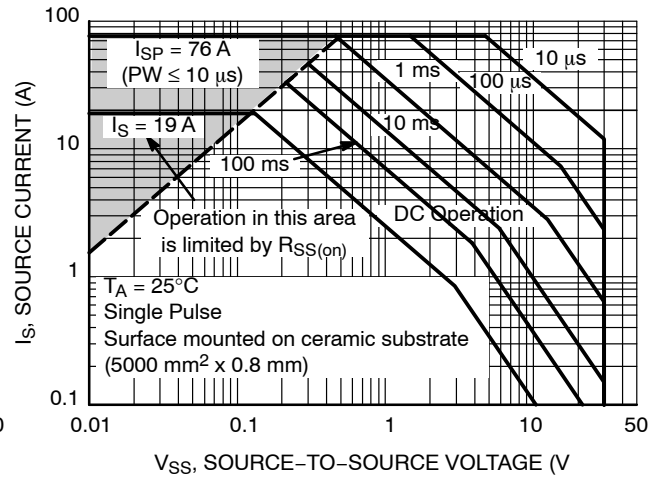


Figure 7. Switching Time vs. Gate Resistance

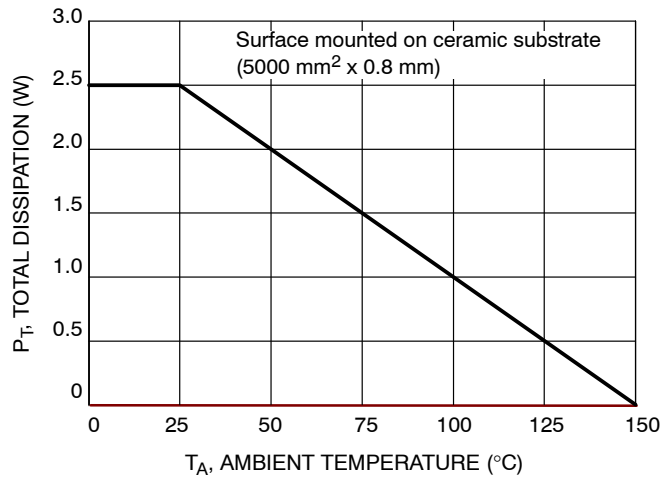
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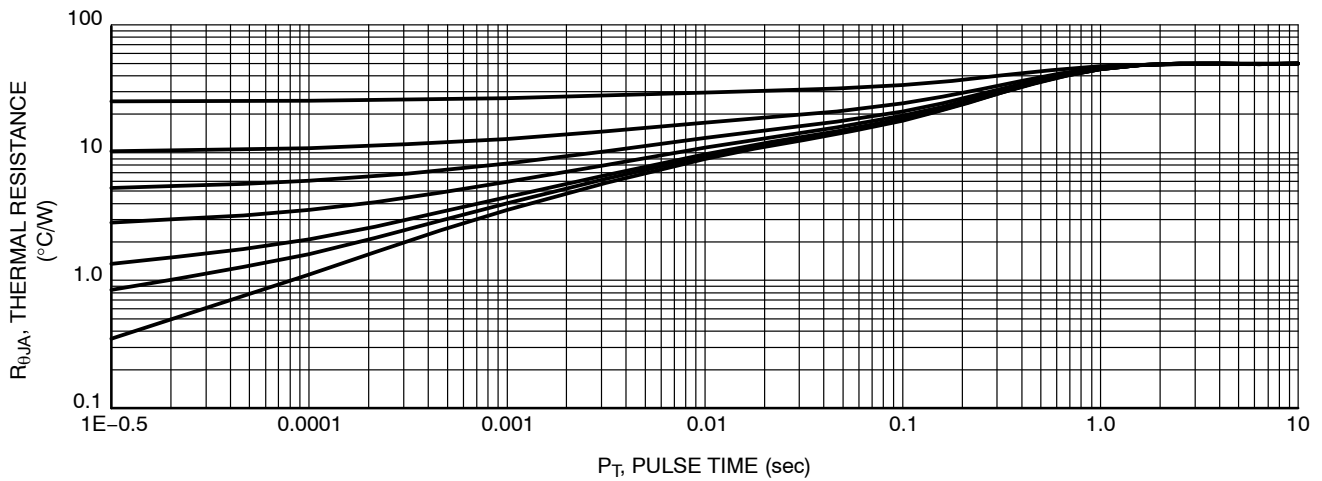
**Figure 8. Gate-to-Source Voltage vs. Total Charge**



**Figure 9. Safe Operating Area**



**Figure 10. Total Dissipation vs. Temperature**



**Figure 11. Thermal Response**

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## ORDERING INFORMATION

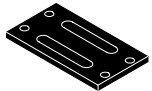
Device	Marking	Package	Shipping (Qty / Packing) <sup>†</sup>
EFC4C012NLTDG	NP	WLCSP6 3.5x1.9x0.21 (Pb-Free / Halogen Free)	5000 / Tape & Reel

<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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

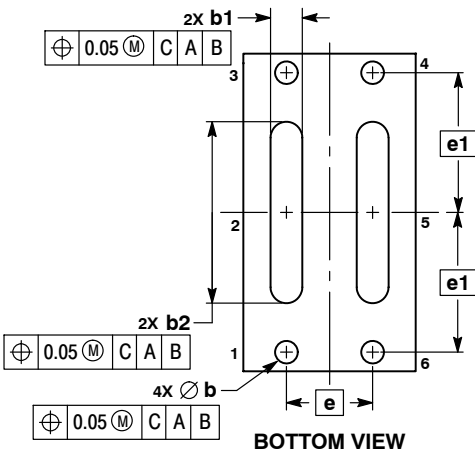
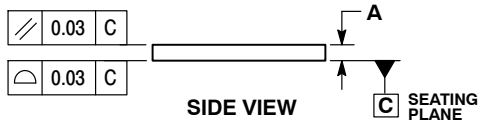
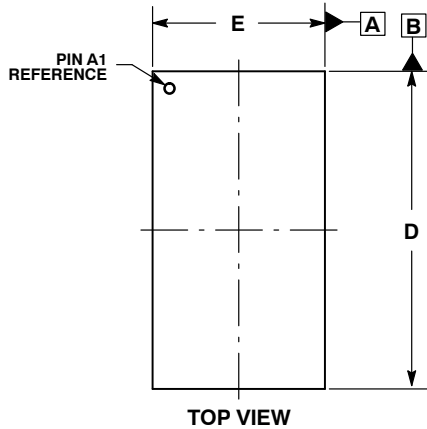
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SCALE 4:1

WLCSP6 3.5x1.9x0.21  
CASE 567SZ  
ISSUE A

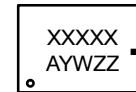
DATE 24 APR 2017



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

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.19	0.21	0.23
b	0.22	0.25	0.28
b1	0.32	0.35	0.38
b2	1.97	2.00	2.03
D	3.47	3.50	3.53
E	1.87	1.90	1.93
e	0.95 BSC		
e1	1.54 BSC		

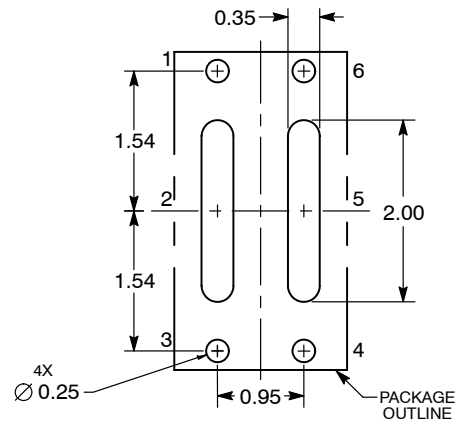
### GENERIC MARKING DIAGRAM\*



- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Assembly Lot
- = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

### 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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DESCRIPTION:	WLCSP6 3.5x1.9x0.21	PAGE 1 OF 1

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