

# EFC6604R

## Power MOSFET for 1-Cell Lithium-ion Battery Protection 12V, 9.0mΩ, 13A, Dual N-Channel



ON Semiconductor®

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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-cell lithium-ion battery applications.

### Features

- 2.5V drive
- 2kV ESD HBM
- Common-Drain Type
- ESD Diode-Protected Gate
- Pb-Free, Halogen Free and RoHS compliance

### Applications

- 1-Cell Lithium-ion Battery Charging and Discharging Switch

### SPECIFICATIONS

**ABSOLUTE MAXIMUM RATINGS** at Ta = 25°C (Note 1)

Parameter	Symbol	Value	Unit
Source to Source Voltage	V <sub>SSS</sub>	12	V
Gate to Source Voltage	V <sub>GSS</sub>	±12	V
Source Current (DC)	I <sub>S</sub>	13	A
Source Current (Pulse) PW≤10μs, duty cycle≤1%	I <sub>SP</sub>	60	A
Total Dissipation Surface mounted on ceramic substrate (5000mm <sup>2</sup> × 0.8mm)	P <sub>T</sub>	1.6	W
Junction Temperature	T <sub>J</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C

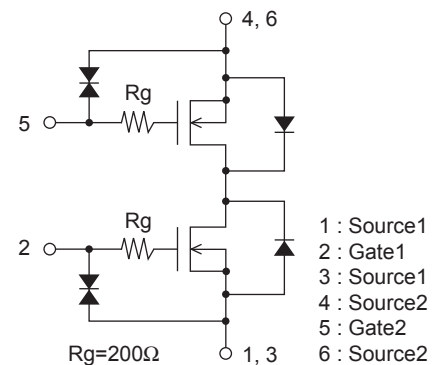
Note 1 : Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE RATINGS

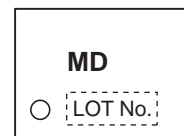
Parameter	Symbol	Value	Unit
Junction to Ambient Surface mounted on ceramic substrate (5000mm <sup>2</sup> × 0.8mm)	R <sub>θJA</sub>	78.1	°C/W

V <sub>SSS</sub>	R <sub>SS(on)</sub> Max	I <sub>S</sub> Max
12V	9.0mΩ@ 4.5V	13A
	9.7mΩ@ 4.0V	
	10.0mΩ@ 3.8V	
	12.7mΩ@ 3.1V	
	17.7mΩ@ 2.5V	

### ELECTRICAL CONNECTION N-Channel



### MARKING



### ORDERING INFORMATION

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

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### ELECTRICAL CHARACTERISTICS at Ta = 25°C (Note 2)

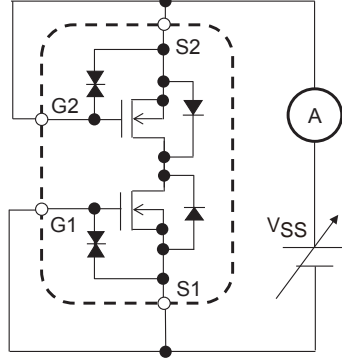
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Source to Source Breakdown Voltage	V(BR)SSS	IS=1mA, VGS=0V Test Circuit 1	12			V
Zero-Gate Voltage Source Current	ISSS	VSS=10V, VGS=0V Test Circuit 1			1	μA
Gate to Source Leakage Current	IGSS	VGS=±8V, VSS=0V Test Circuit 2			±1.0	μA
Gate Threshold Voltage	VGS(th)	VSS=6V, IS=1mA Test Circuit 3	0.5		1.3	V
Forward Transconductance	gFS	VSS=6V, IS=3A Test Circuit 4		13.7		S
Static Source to Source On-State Resistance	RSS(on)1	IS=3A, VGS=4.5V Test Circuit 5	6.0	7.5	9.0	mΩ
	RSS(on)2	IS=3A, VGS=4.0V Test Circuit 5	6.4	8.1	9.7	mΩ
	RSS(on)3	IS=3A, VGS=3.8V Test Circuit 5	6.7	8.4	10.0	mΩ
	RSS(on)4	IS=3A, VGS=3.1V Test Circuit 5	7.8	9.8	12.7	mΩ
	RSS(on)5	IS=3A, VGS=2.5V Test Circuit 5	10.0	12.6	17.7	mΩ
Turn-ON Delay Time	td(on)	VSS=6V, VGS=4.5V, IS=3A Test Circuit 6		300		ns
Rise Time	tr			1200		ns
Turn-OFF Delay Time	td(off)			5200		ns
Fall Time	tf			3900		ns
Total Gate Charge	Qg	VSS=6V, VGS=4.5V, IS=13A Test Circuit 7		29		nC
Forward Source to Source Voltage	VF(S-S)	IS=3A, VGS=0V Test Circuit 8		0.75	1.2	V

Note 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.

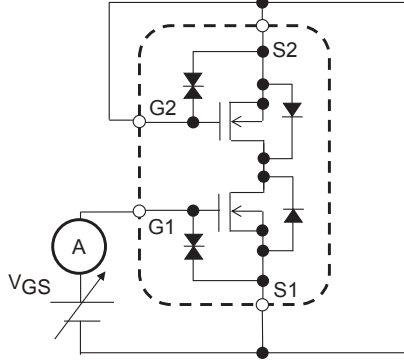
# EFC6604R

Test circuits are example of measuring FET1 side

Test Circuit 1  
V<sub>SSS</sub> / I<sub>SSS</sub>

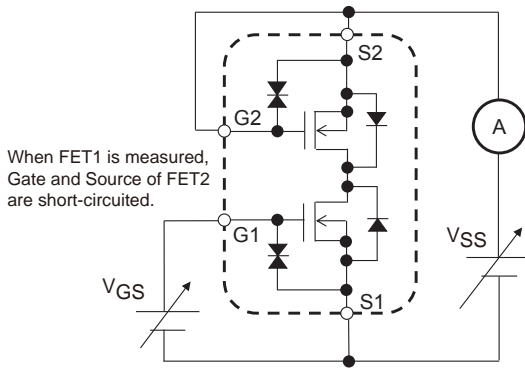


Test Circuit 2  
I<sub>GSS</sub>



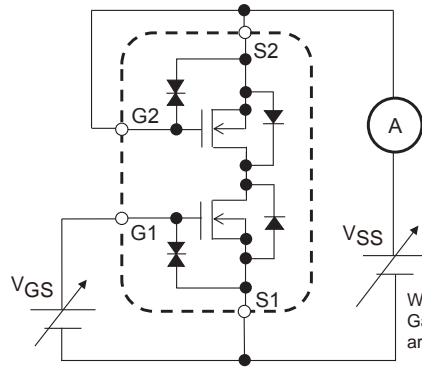
When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 3  
V<sub>GS(th)</sub>



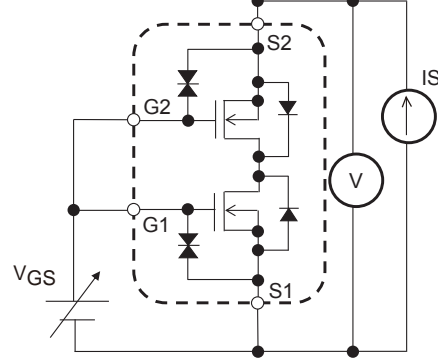
When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 4  
g<sub>FS</sub>

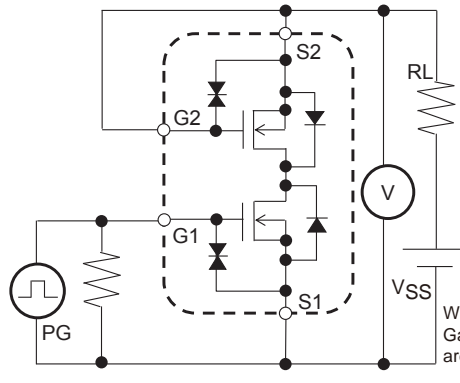


When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 5  
R<sub>SS(on)</sub>

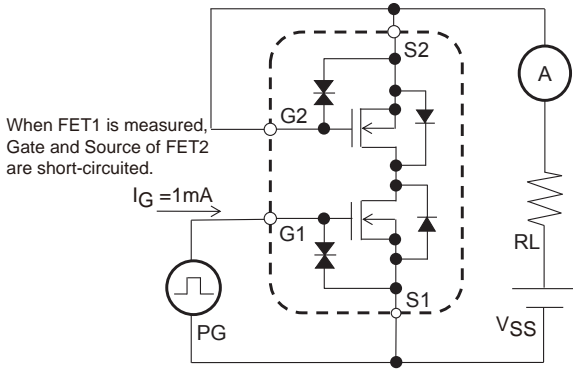


Test Circuit 6  
t<sub>d(on)</sub>, t<sub>r</sub>, t<sub>d(off)</sub>, t<sub>f</sub>



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

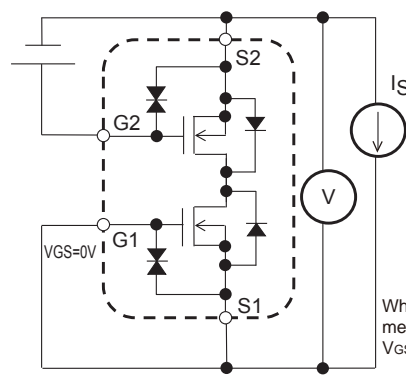
Test Circuit 7  
Q<sub>g</sub>



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

I<sub>G</sub> = 1mA

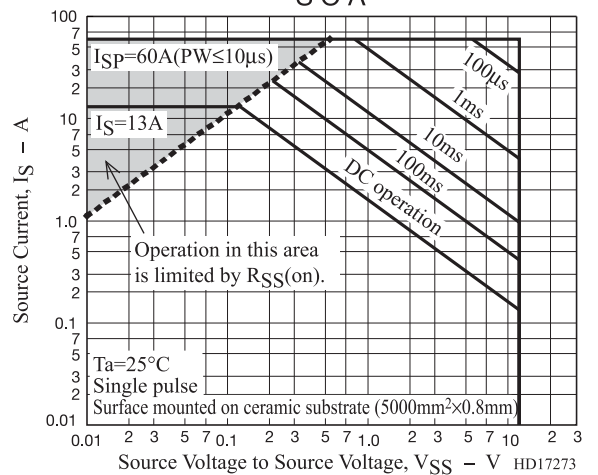
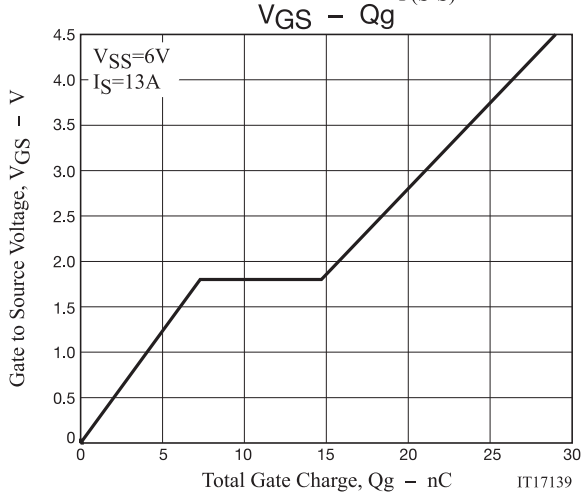
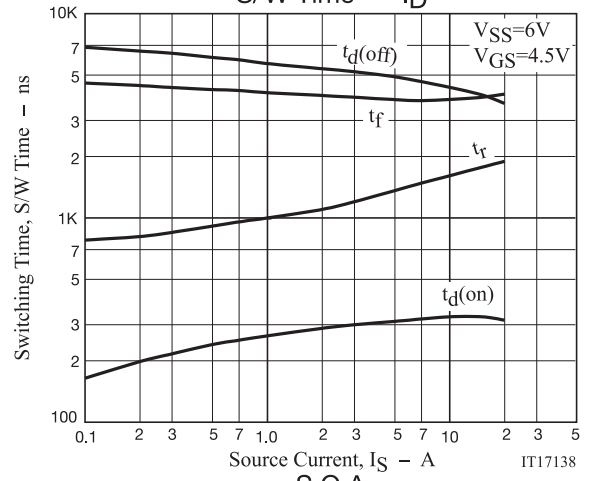
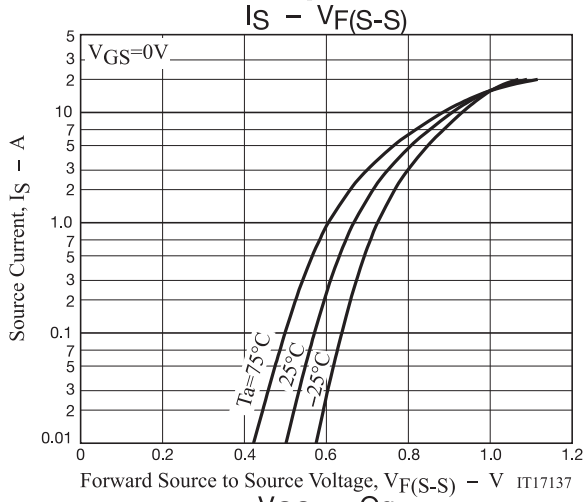
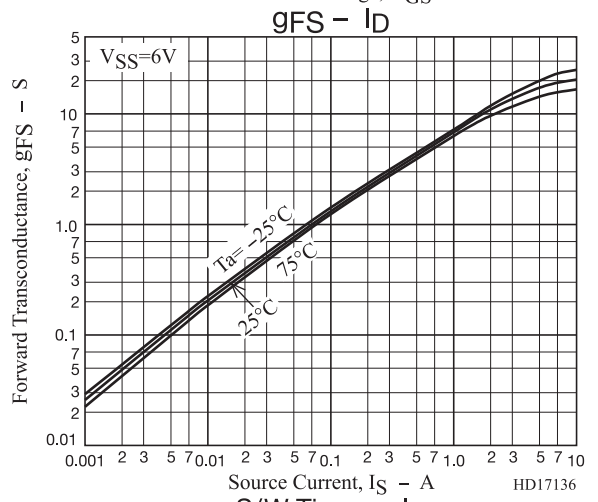
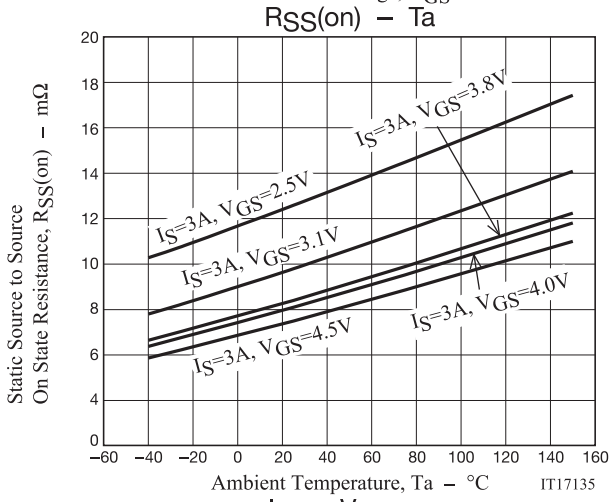
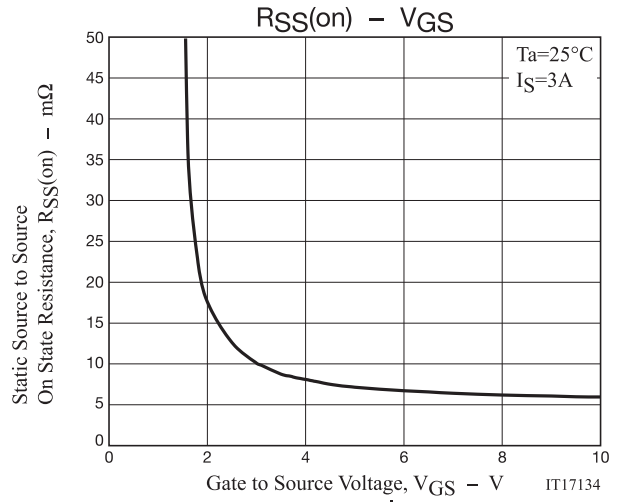
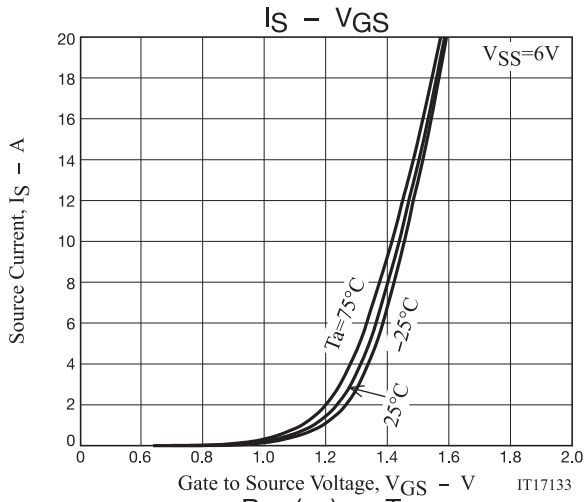
Test Circuit 8  
V<sub>F(S-S)</sub>



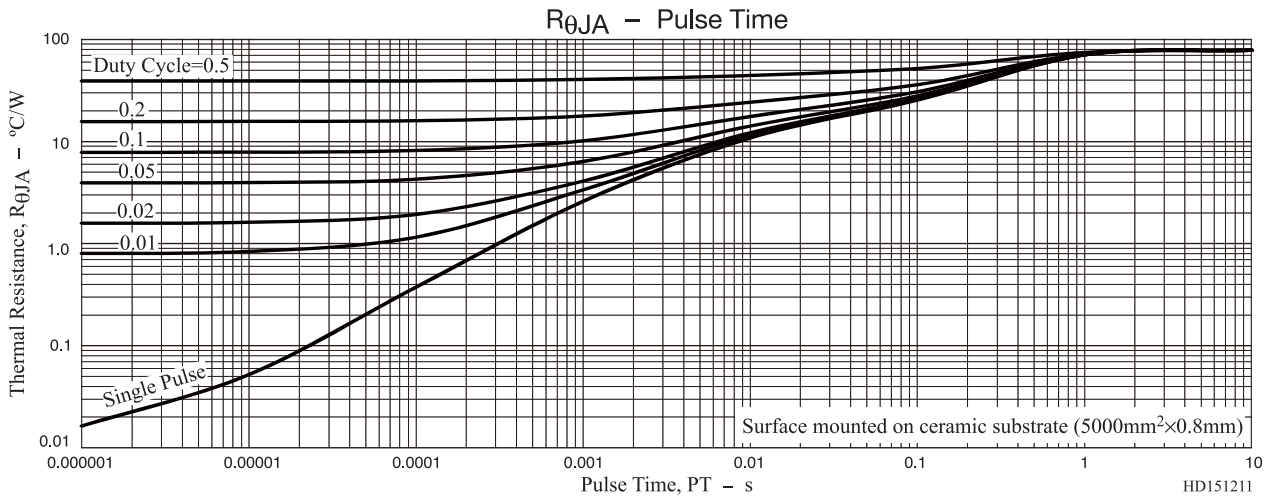
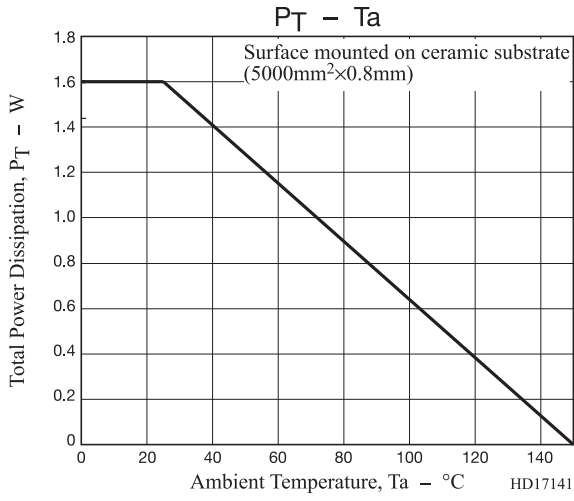
When FET1 is measured, +4.5V is added to V<sub>GS</sub> of FET2.

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

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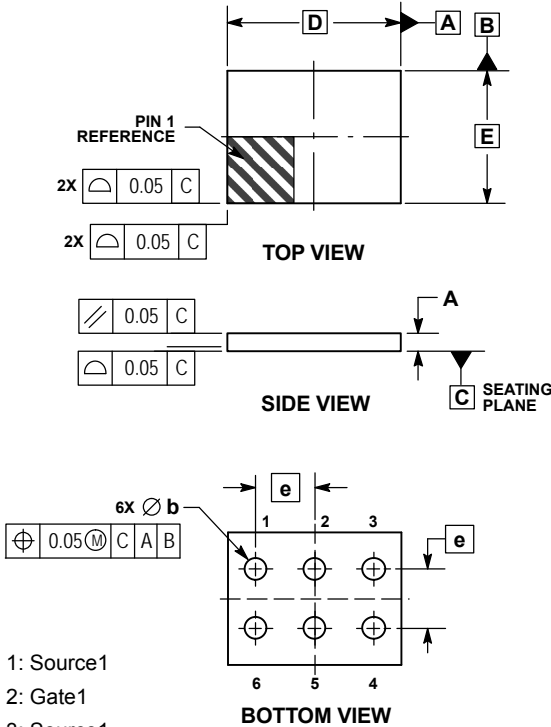
## PACKAGE DIMENSIONS

unit : mm

### WLCSP6 1.91x1.46 / EFCP1915-6CE-020

CASE 614AC

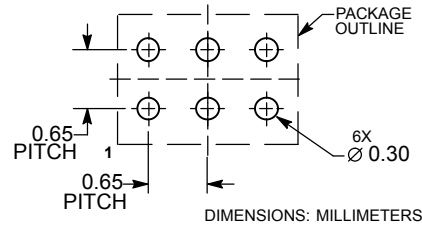
ISSUE B



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

DIM	MILLIMETERS	
	MIN	MAX
A	0.18	0.22
b	0.27	0.33
D	1.91 BSC	
E	1.46 BSC	
e	0.65 BSC	

### RECOMMENDED SOLDERING FOOTPRINT\*



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

## ORDERING INFORMATION

Device	Marking	Package	Shipping (Qty / Packing)
EFC6604R-TR	MD	WLCSP6 1.91x1.46 / EFCP1915-6CE-020 (Pb-Free / Halogen Free)	5,000 / Tape & Reel

† 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. [http://www.onsemi.com/pub\\_link/Collateral/BRD8011-D.PDF](http://www.onsemi.com/pub_link/Collateral/BRD8011-D.PDF)

Note on usage : Since the EFC6604R 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.

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