EFC6604R

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

ON Semiconductor®

www.onsemi.com

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.

V_{SSS}	R_{SS}(on) Max	I_S Max
12V	9.0mΩ@ 4.5V	13A
	9.7mΩ@ 4.0V	
	10.0mΩ@ 3.8V	
	12.7mΩ@ 3.1V	
	17.7mΩ@ 2.5V	

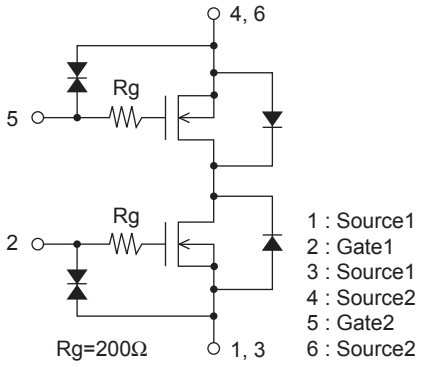
Features

- 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

ELECTRICAL CONNECTION
N-Channel



SPECIFICATIONS

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

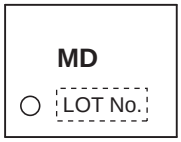
Parameter	Symbol	Value	Unit
Source to Source Voltage	V_{SSS}	12	V
Gate to Source Voltage	V_{GSS}	±12	V
Source Current (DC)	I_S	13	A
Source Current (Pulse) PW≤10μs, duty cycle≤1%	I_{SP}	60	A
Total Dissipation Surface mounted on ceramic substrate (5000mm^2 × 0.8mm)	P_T	1.6	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	−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^2 × 0.8mm)	$R_{\theta JA}$	78.1	°C/W

MARKING



ORDERING INFORMATION

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

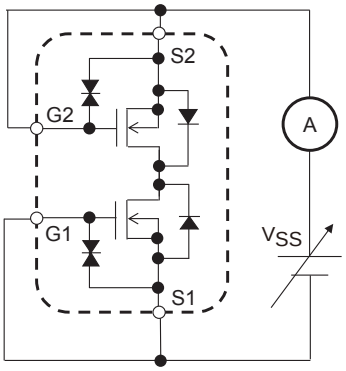
ELECTRICAL CHARACTERISTICS at Ta = 25°C (Note 2)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Source to Source Breakdown Voltage	$V_{(BR)SSS}$	I_S=1mA, V_{GS}=0V Test Circuit 1	12			V
Zero-Gate Voltage Source Current	I_{SSS}	V_{SS}=10V, V_{GS}=0V Test Circuit 1			1	μA
Gate to Source Leakage Current	I_{GSS}	V_{GS}=±8V, V_{SS}=0V Test Circuit 2			±1.0	μA
Gate Threshold Voltage	V_{GS}(th)	V_{SS}=6V, I_S=1mA Test Circuit 3	0.5		1.3	V
Forward Transconductance	g_{FS}	V_{SS}=6V, I_S=3A Test Circuit 4		13.7		S
Static Source to Source On-State Resistance	R_{SS}(on)1	I_S=3A, V_{GS}=4.5V Test Circuit 5	6.0	7.5	9.0	mΩ
	R_{SS}(on)2	I_S=3A, V_{GS}=4.0V Test Circuit 5	6.4	8.1	9.7	mΩ
	R_{SS}(on)3	I_S=3A, V_{GS}=3.8V Test Circuit 5	6.7	8.4	10.0	mΩ
	R_{SS}(on)4	I_S=3A, V_{GS}=3.1V Test Circuit 5	7.8	9.8	12.7	mΩ
	R_{SS}(on)5	I_S=3A, V_{GS}=2.5V Test Circuit 5	10.0	12.6	17.7	mΩ
Turn-ON Delay Time	t_{d}(on)	V_{SS}=6V, V_{GS}=4.5V, I_S=3A Test Circuit 6		300		ns
Rise Time	t_r			1200		ns
Turn-OFF Delay Time	t_{d}(off)			5200		ns
Fall Time	t_f			3900		ns
Total Gate Charge	Qg	V_{SS}=6V, V_{GS}=4.5V, I_S=13A Test Circuit 7		29		nC
Forward Source to Source Voltage	$V_{F(S-S)}$	I_S=3A, V_{GS}=0V Test Circuit 8		0.75	1.2	V

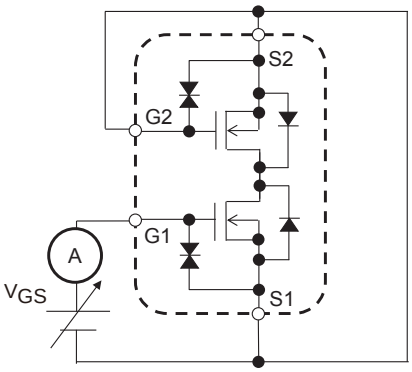
Note 2 : Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Test circuits are example of measuring FET1 side

Test Circuit 1
V_{SSS} / I_{SSS}

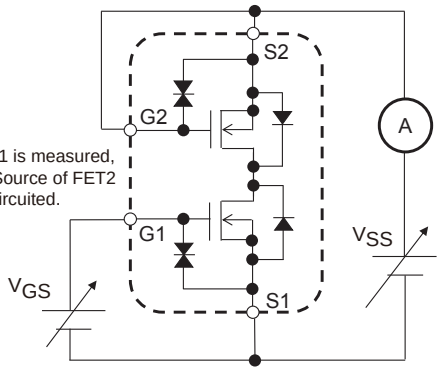


Test Circuit 2
I_{GSS}



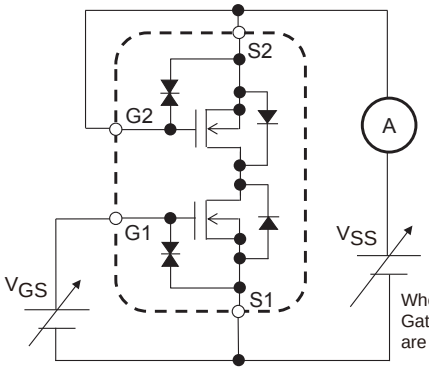
When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 3
$V_{GS(th)}$



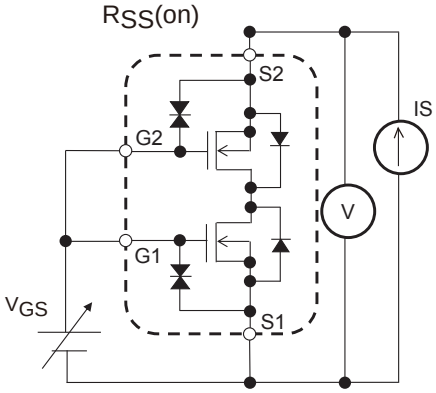
When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 4
g_{FS}

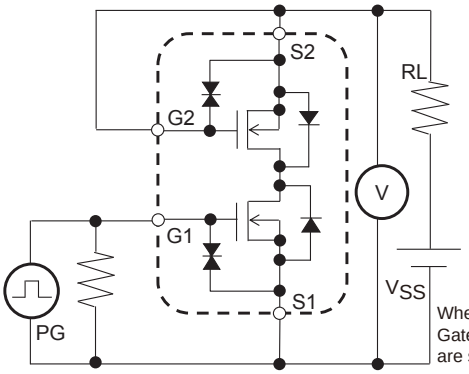


When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 5
$R_{SS(on)}$

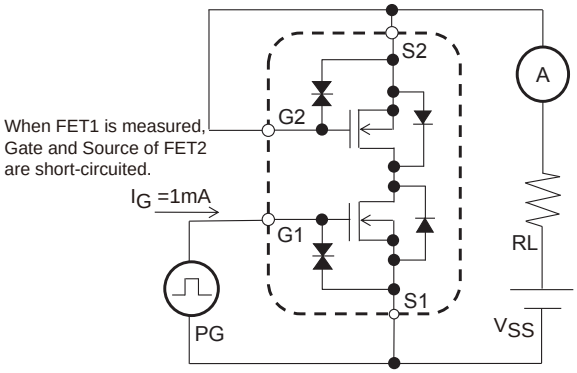


Test Circuit 6
$t_{d(on)}$, t_r, $t_{d(off)}$, t_f



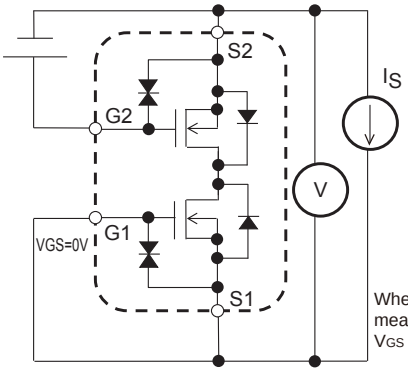
When FET1 is measured, Gate and Source of FET2 are short-circuited.

Test Circuit 7
Qg



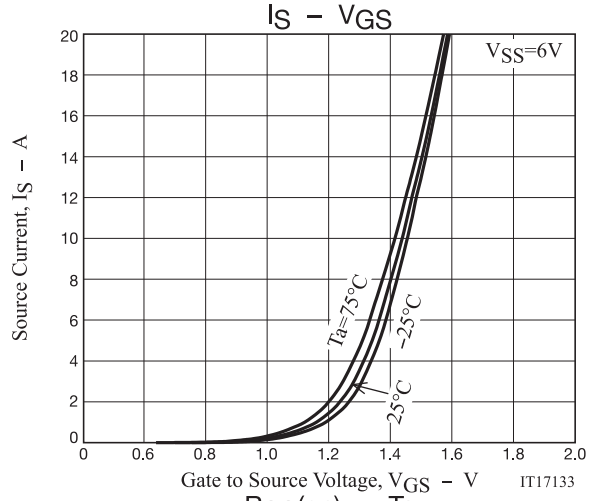
When FET1 is measured, Gate and Source of FET2 are short-circuited.

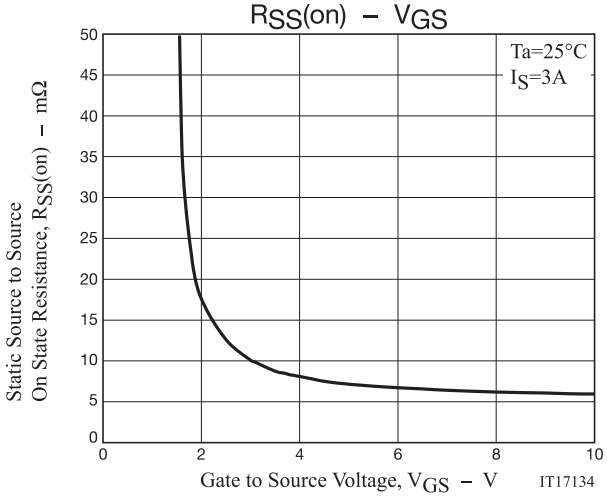
Test Circuit 8
$V_{F(S-S)}$

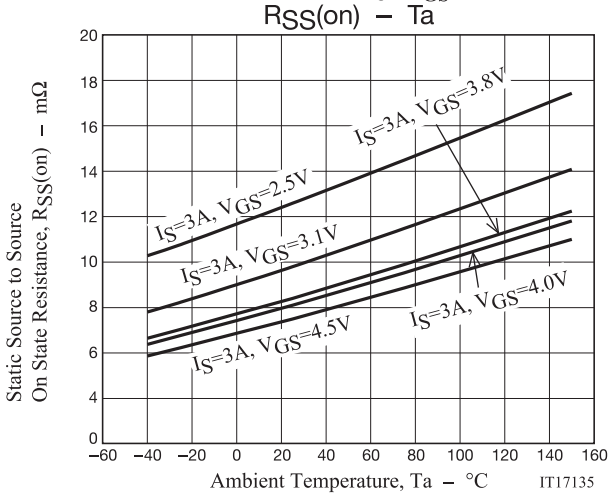


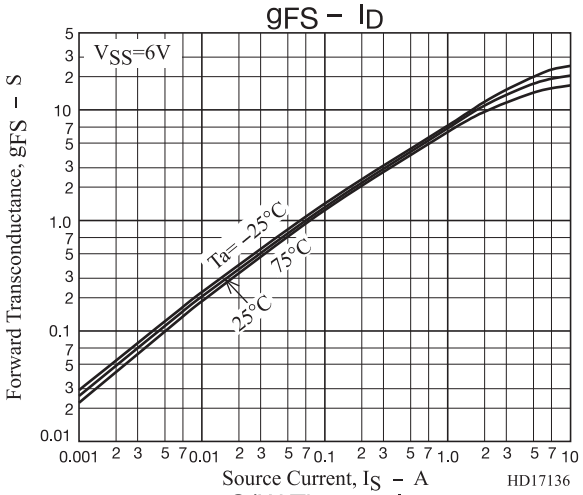
When FET1 is measured,+4.5V is added to V_{GS} of FET2.

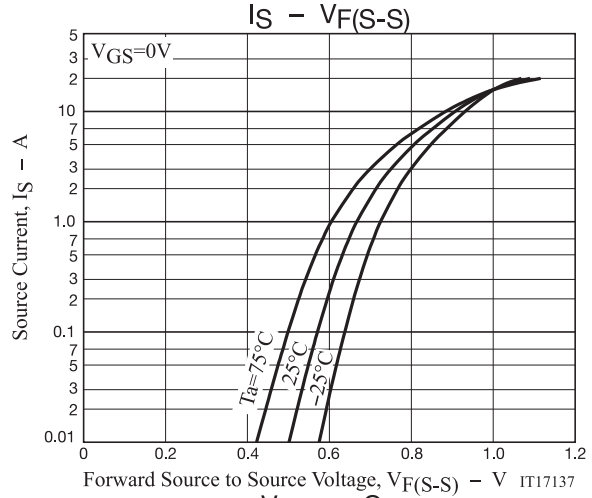
When FET2 is measured, the position of FET1 and FET2 is switched.

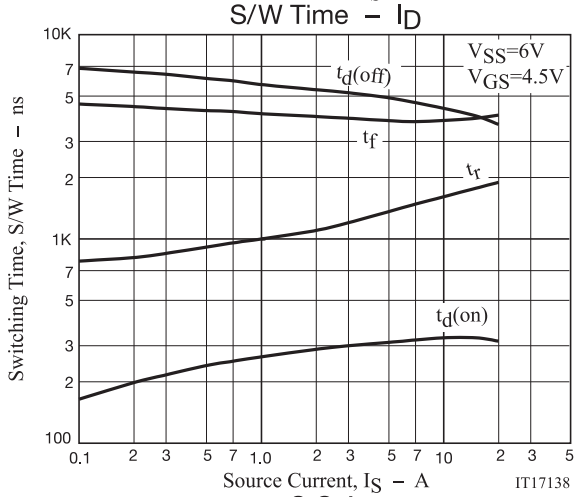

IS – VGS
VSS=6V
Ta=75°C
25°C
–25°C
Source Current, IS – A
Gate to Source Voltage, VGS – V
IT17133

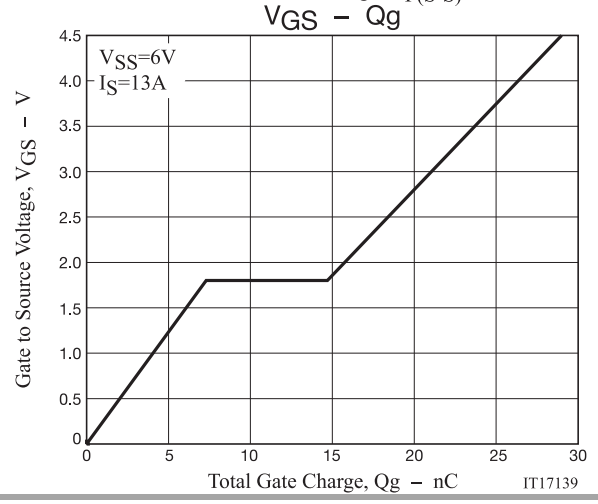

RSS(on) – VGS
Ta=25°C
IS=3A
Static Source to Source
On State Resistance, RSS(on) – mΩ
Gate to Source Voltage, VGS – V
IT17134

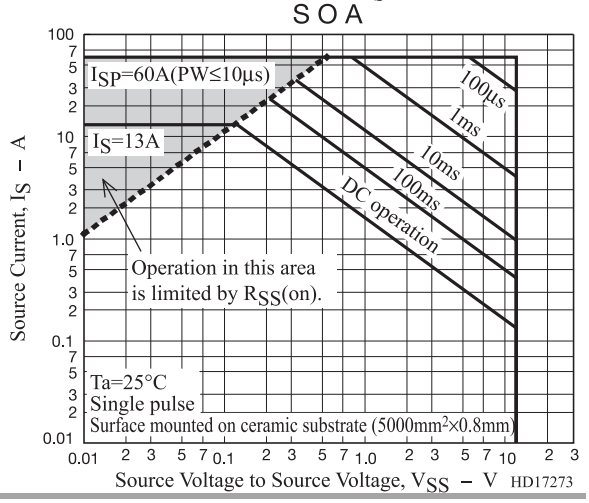

RSS(on) – Ta
IS=3A, VGS=3.8V
IS=3A, VGS=2.5V
IS=3A, VGS=3.1V
IS=3A, VGS=4.0V
IS=3A, VGS=4.5V
Static Source to Source
On State Resistance, RSS(on) – mΩ
Ambient Temperature, Ta – °C
IT17135

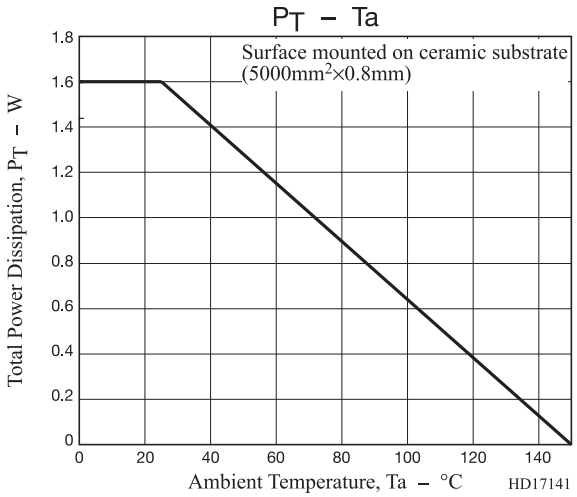

gFS – ID
VSS=6V
Ta= –25°C
75°C
25°C
Forward Transconductance, gFS – S
Source Current, IS – A
HD17136

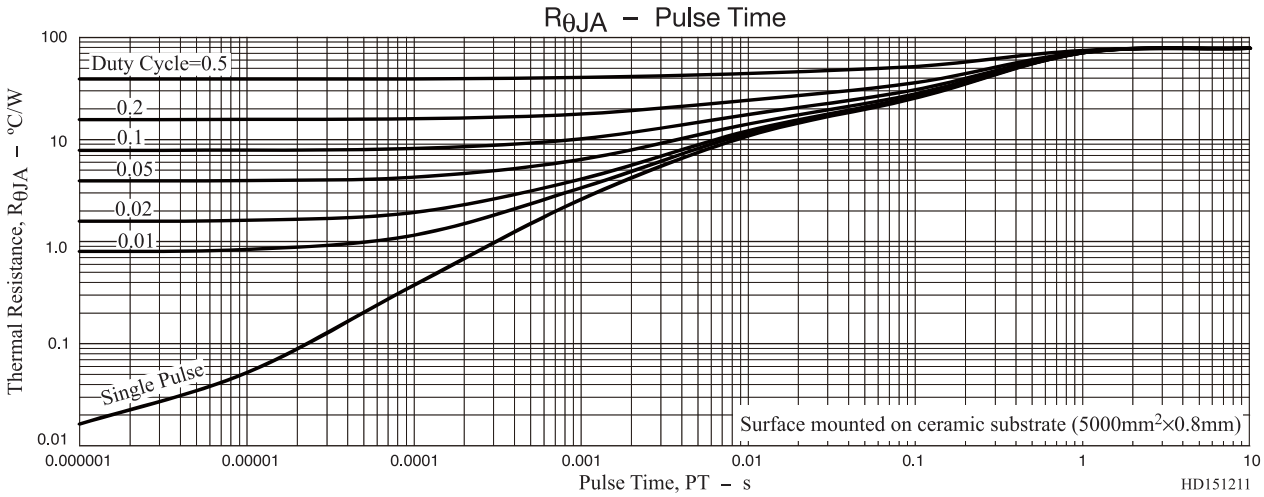

IS – VF(S-S)
VGS=0V
Ta=75°C
25°C
–25°C
Source Current, IS – A
Forward Source to Source Voltage, VF(S-S) – V
IT17137


S/W Time – ID
VSS=6V
VGS=4.5V
td(off)
tf
tr
td(on)
Switching Time, S/W Time – ns
Source Current, IS – A
IT17138


VGS – Qg
VSS=6V
IS=13A
Gate to Source Voltage, VGS – V
Total Gate Charge, Qg – nC
IT17139

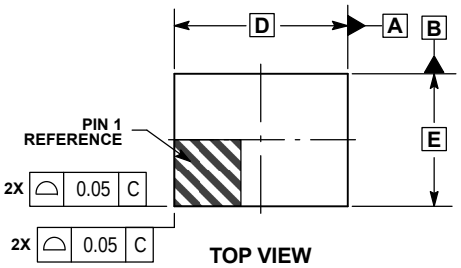

SOA
ISP=60A(PW≤10μs)
IS=13A
100μs
1ms
10ms
100ms
DC operation
Operation in this area
is limited by RSS(on).
Ta=25°C
Single pulse
Surface mounted on ceramic substrate (5000mm²×0.8mm)
Source Current, IS – A
Source Voltage to Source Voltage, VSS – V
HD17273

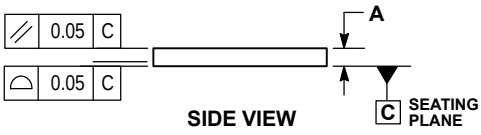

PT – Ta
Surface mounted on ceramic substrate
(5000mm2×0.8mm)
Total Power Dissipation, PT – W
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
120
140
Ambient Temperature, Ta – °C
HD17141

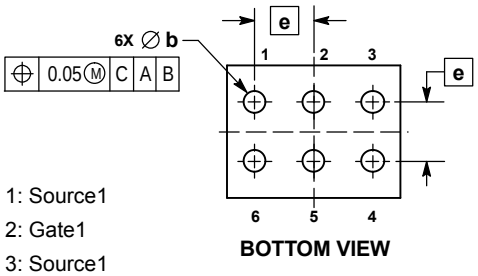

RθJA – Pulse Time
Thermal Resistance, RθJA – °C/W
100
10
1.0
0.1
0.01
Duty Cycle=0.5
0.2
0.1
0.05
0.02
0.01
Single Pulse
Surface mounted on ceramic substrate (5000mm2×0.8mm)
0.000001
0.00001
0.0001
0.001
0.01
0.1
1
10
Pulse Time, PT – s
HD151211

PACKAGE DIMENSIONS
unit : mm

WLCSP6 1.91x1.46 / EFCP1915-6CE-020
CASE 614AC
ISSUE B





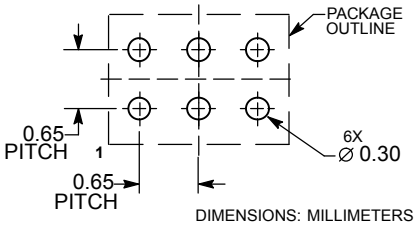


1: Source1
2: Gate1
3: Source1
4: Source2
5: Gate2
6: Source2

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

	MILLIMETERS	
DIM	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*



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.

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

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.

Mouser Electronics

Authorized Distributor

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ON Semiconductor:

EFC6604R-TR