MOSFET – Power, for 1-Cell Lithium-ion Battery Protection, Dual N-Channel

12 V, 13 A, 9.0 mΩ

EFC6604R

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

- 2.5 V Drive
- 2 kV ESD HBM
- Common−Drain Type
- ESD Diode−Protected Gate
- This Device is Pb−Free, Halogen Free/BFR Free and is RoHS Compliant

Applications

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

Specifications

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

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 ≤ 10 μs, duty cycle ≤ 1%	I_{SP}	60	A
Total Dissipation (Note 1)	P_T	1.6	W
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	− 55 to +150	°C

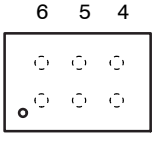
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Value	Unit
Junction to Ambient (Note 1)	$R_{\theta JA}$	78.1	°C/W

1. Surface mounted on ceramic substrate (5000 mm^2 x 0.8 mm)

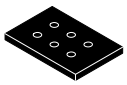
PIN ASSIGNMENT



(Top View)

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

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



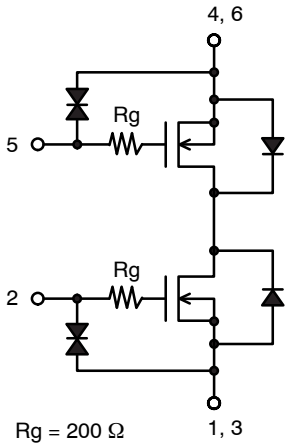
WLCSP6 1.91x1.46 / EFCP1915−6CE−020
CASE 614AC

MARKING DIAGRAM

MD = Specific Device Code
Y = Year of Production
M = Assembly Operation Month
ZZ = Assembly Lot Number

ELECTRICAL CONNECTION

N−Channel



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

ORDERING INFORMATION

Device	Package	Shipping
EFC6604R−TR	WLCSP6 (Pb−Free and Halogen Free)	5000 / 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.

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ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Source−to−Source Breakdown Voltage	$V_{(BR)SSS}$	I_S = 1 mA, V_{GS} = 0 V	Test Circuit 1	12	–	–	V
Zero−Gate Voltage Source Current	I_{SSS}	V_{SS} = 10 V, V_{GS} = 0 V	Test Circuit 1	–	–	1	μA
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = ±8 V, V_{SS} = 0 V	Test Circuit 2	–	–	±1.0	μA
Gate Threshold Voltage	V_{GS}(th)	V_{SS} = 6 V, I_S = 1 mA	Test Circuit 3	0.5	–	1.3	V
Forward Transconductance	g_{FS}	V_{SS} = 6 V, I_S = 3 A	Test Circuit 4	–	13.7	–	S
Static Source−to−Source On−State Resistance	R_{SS}(on)1	I_S = 3 A, V_{GS} = 4.5 V	Test Circuit 5	6.0	7.5	9.0	mΩ
	R_{SS}(on)2	I_S = 3 A, V_{GS} = 4.0 V	Test Circuit 5	6.4	8.1	9.7	mΩ
	R_{SS}(on)3	I_S = 3 A, V_{GS} = 3.8 V	Test Circuit 5	6.7	8.4	10.0	mΩ
	R_{SS}(on)4	I_S = 3 A, V_{GS} = 3.1 V	Test Circuit 5	7.8	9.8	12.7	mΩ
	R_{SS}(on)5	I_S = 3 A, V_{GS} = 2.5 V	Test Circuit 5	10.0	12.6	17.7	mΩ
Turn−ON Delay Time	t_d(on)	V_{SS} = 6 V, V_{GS} = 4.5 V, I_S = 3 A	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} = 6 V, V_{GS} = 4.5 V, I_S = 13 A	Test Circuit 7	–	29	–	nC
Forward Source−to−Source Voltage	$V_{F(S-S)}$	I_S = 3 A, V_{GS} = 0 V	Test Circuit 8	–	0.75	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.

Test circuits are example of measuring FET1 side.

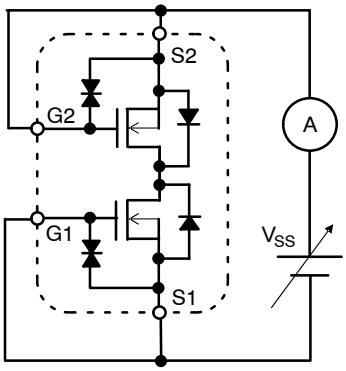
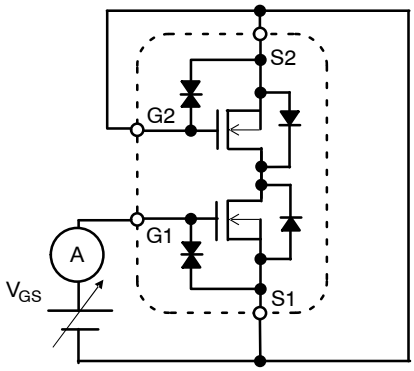


Figure 1. Test Circuit 1 – V_{SSS} / I_{SSS}



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

Figure 2. Test Circuit 2 – I_{GSS}

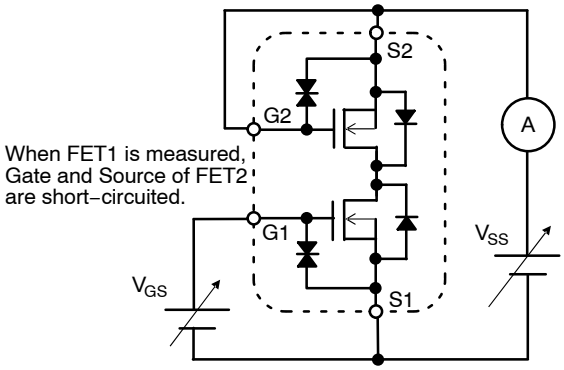
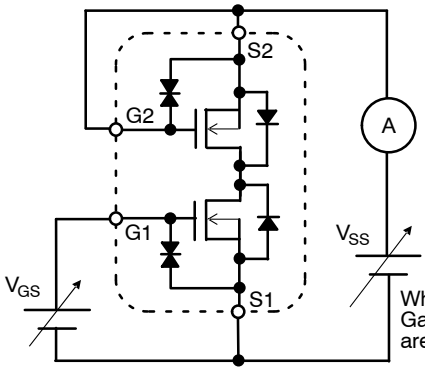


Figure 3. Test Circuit 3 – V_{GS}(th)



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

Figure 4. Test Circuit 4 – g_{FS}

TEST CIRCUITS (continued)

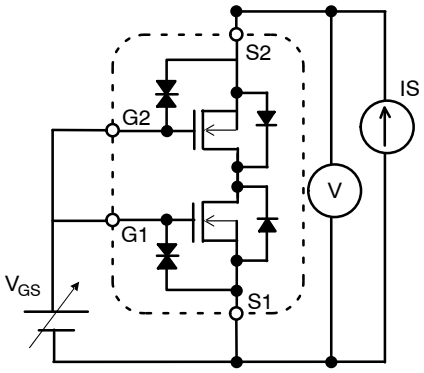


Figure 5. Test Circuit 5 – R_{SS}(on)

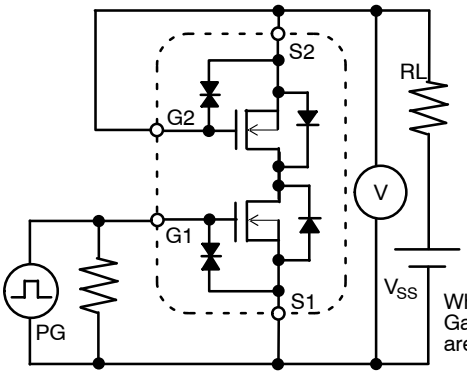


Figure 6. Test Circuit 6 – t_d(on), t_r, t_d(off), t_f

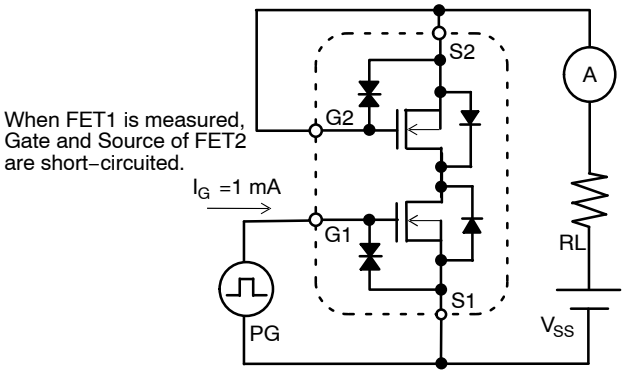


Figure 7. Test Circuit 7 – Qg

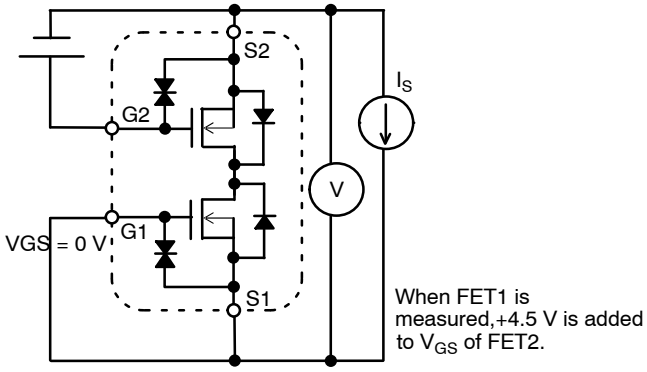


Figure 8. Test Circuit 8 – $V_{F(S-S)}$

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

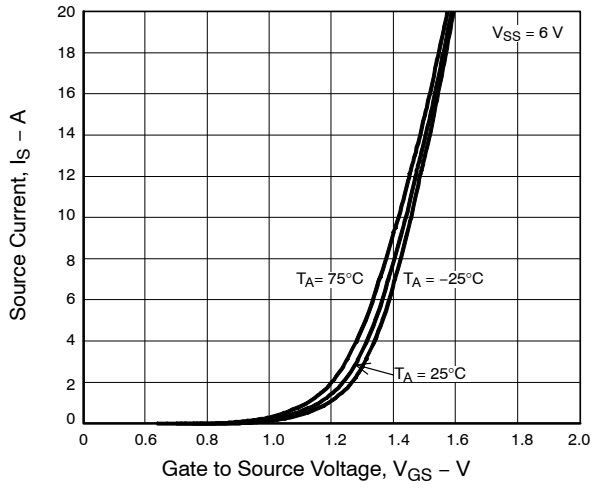


Figure 9. I_S – V_{GS}

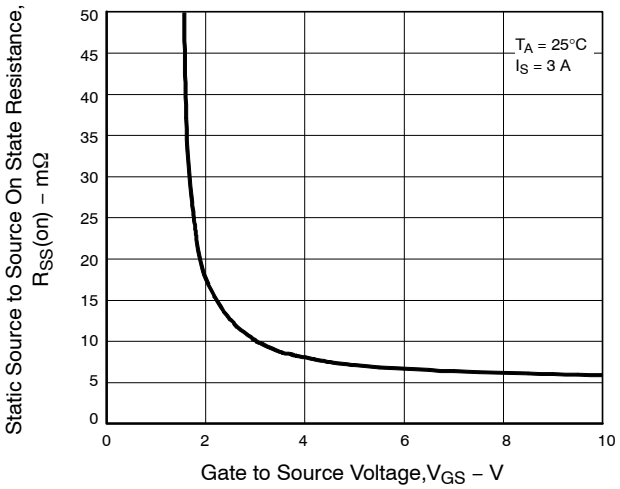


Figure 10. R_{SS}(on) – V_{GS}

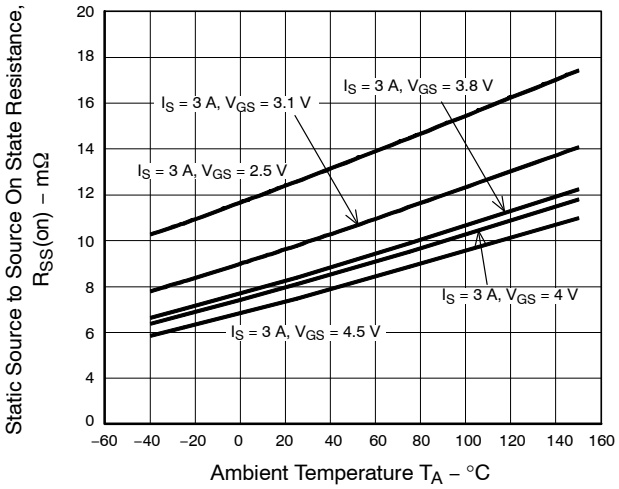


Figure 11. R_{SS}(on) – T_A

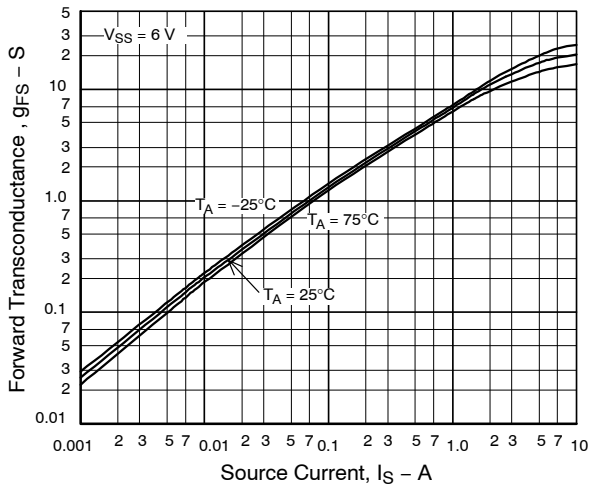


Figure 12. g_{FS} – I_S

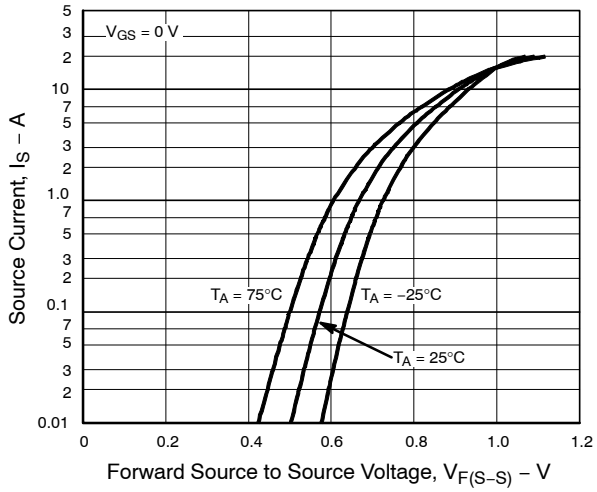


Figure 13. I_S – $V_{F(S–S)}$

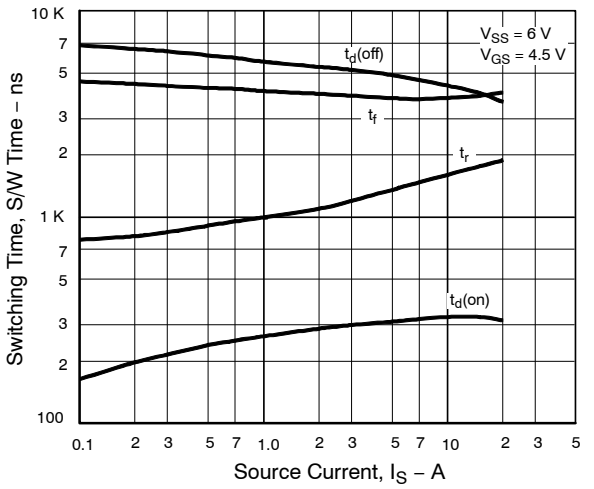


Figure 14. S/W Time – I_S

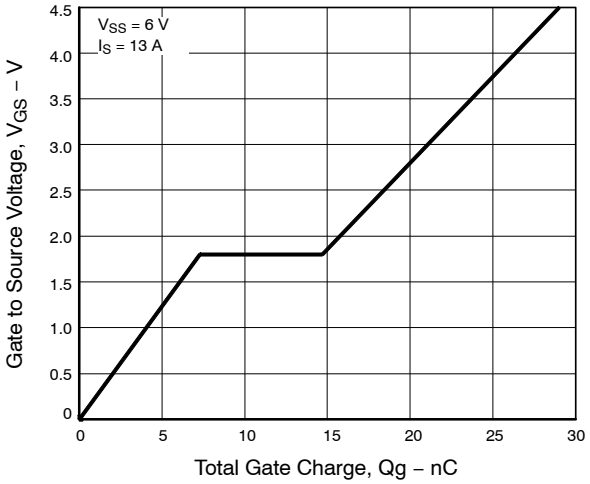


Figure 15. V_{GS} – Qg

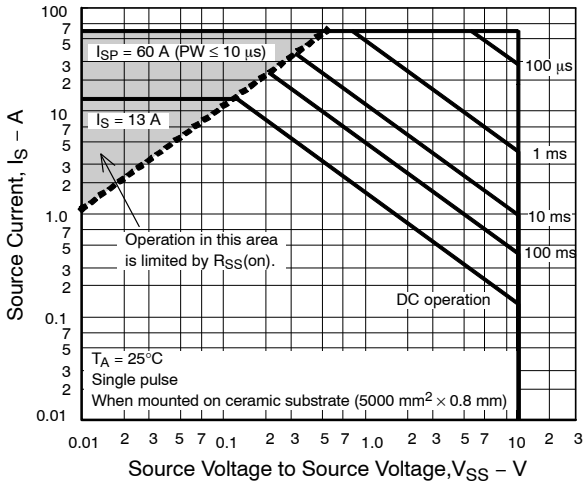


Figure 16. SOA

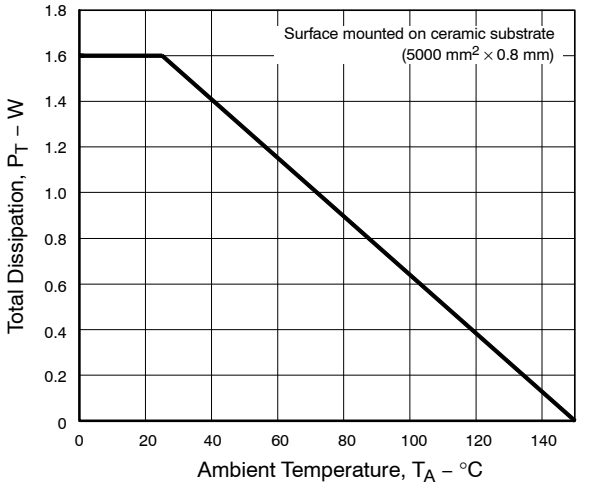


Figure 17. P_T – T_A

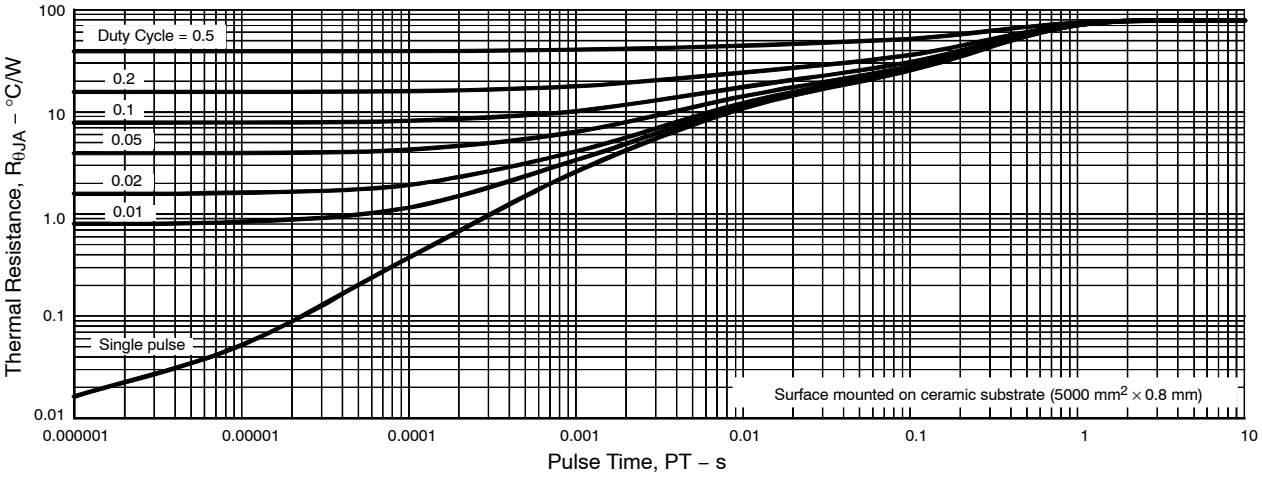


Figure 18. $R_{\theta JA}$ – Pulse Time

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.

SCALE 4:1

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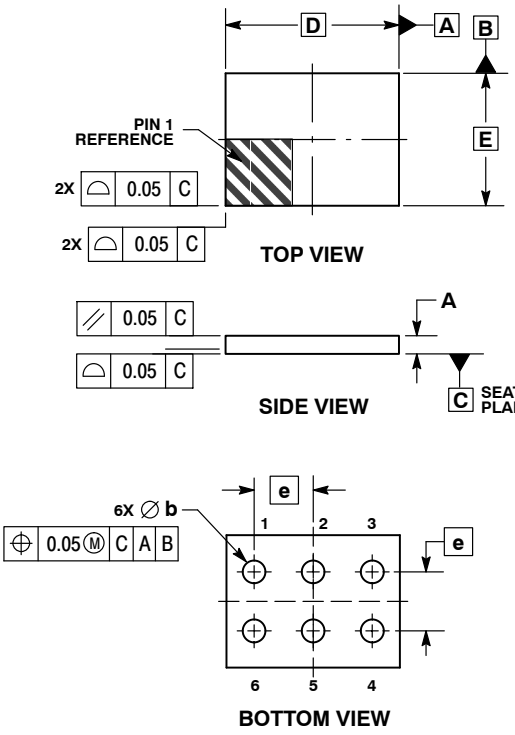
CASE 614AC
ISSUE B

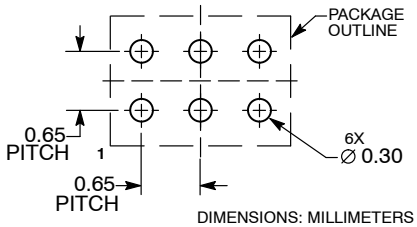
DATE 09 JAN 2015



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 **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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