

# MOSFET – Power, N-Channel, Dual, EFCP

24 V, 13 A, 11.5 mΩ

## EFC6601R

### Features

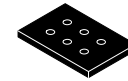
- 2.5 V Drive
- Common–drain Type
- 2 kV ESD HBM
- Protection Diode In
- This Device is Pb–Free, Halogen Free/BFR Free and is RoHS Compliant

### Specifications

#### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C)

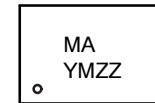
Parameter	Symbol	Conditions	Ratings	Unit
Source–to–Source Voltage	V <sub>SSS</sub>		24	V
Gate–to–Source Voltage	V <sub>GSS</sub>		±12	V
Source Current (DC)	I <sub>S</sub>		13	A
Source Current (Pulse)	I <sub>SP</sub>	PW ≤ 10 μs, duty cycle ≤ 1%	60	A
Total Dissipation	P <sub>T</sub>	When mounted on ceramic substrate (5000 mm <sup>2</sup> x 0.8 mm)	2.0	W
Channel Temperature	T <sub>ch</sub>		150	°C
Storage Temperature	T <sub>stg</sub>		– 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.



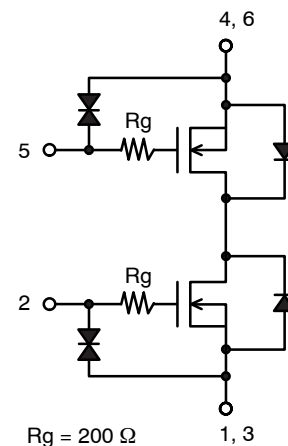
WLCSP6 1.81x2.70 / EFCP2718–6CE–020  
CASE 567HS

### MARKING DIAGRAM

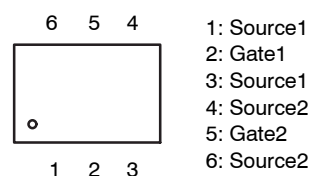


MA = Specific Device Code  
Y = Year of Production  
M = Assembly Operation Month  
ZZ = Assembly Lot Number

### ELECTRICAL CONNECTION



### PIN ASSIGNMENT



### ORDERING INFORMATION

Device	Package	Shipping
EFC6601R–TR	EFCP (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.

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Source-to-Source Breakdown Voltage	$V_{(BR)SSS}$	$I_S = 1 \text{ mA}$ , $V_{GS} = 0 \text{ V}$	Test Circuit 1	24	–	–	V
Zero-Gate Voltage Source Current	$I_{SSS}$	$V_{SS} = 20 \text{ V}$ , $V_{GS} = 0 \text{ V}$	Test Circuit 1	–	–	1	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 8 \text{ V}$ , $V_{SS} = 0 \text{ V}$	Test Circuit 2	–	–	$\pm 1$	$\mu\text{A}$
Cutoff Voltage	$V_{GS(off)}$	$V_{SS} = 10 \text{ V}$ , $I_S = 1 \text{ mA}$	Test Circuit 3	0.5	–	1.3	V
Forward Transfer Admittance	$ y_{fs} $	$V_{SS} = 10 \text{ V}$ , $I_S = 3 \text{ A}$	Test Circuit 4	–	15.5	–	S
Static Source-to-Source On-State Resistance	$R_{SS(on)1}$	$I_S = 3 \text{ A}$ , $V_{GS} = 4.5 \text{ V}$	Test Circuit 5	6.6	9.5	11.5	$\text{m}\Omega$
	$R_{SS(on)2}$	$I_S = 3 \text{ A}$ , $V_{GS} = 4.0 \text{ V}$	Test Circuit 5	7.0	10	12	$\text{m}\Omega$
	$R_{SS(on)3}$	$I_S = 3 \text{ A}$ , $V_{GS} = 3.8 \text{ V}$	Test Circuit 5	7.3	10.5	13	$\text{m}\Omega$
	$R_{SS(on)4}$	$I_S = 3 \text{ A}$ , $V_{GS} = 3.1 \text{ V}$	Test Circuit 5	8.0	11.5	15	$\text{m}\Omega$
	$R_{SS(on)5}$	$I_S = 3 \text{ A}$ , $V_{GS} = 2.5 \text{ V}$	Test Circuit 5	9.0	13	17	$\text{m}\Omega$
Turn-ON Delay Time	$t_{d(on)}$	$V_{DD} = 10 \text{ V}$ , $V_{GS} = 4.5 \text{ V}$ , $I_S = 3 \text{ A}$	Test Circuit 7	–	280	–	ns
Rise Time	$t_r$			–	630	–	ns
Turn-OFF Delay Time	$t_{d(off)}$			–	53000	–	ns
Fall Time	$t_f$			–	47000	–	ns
Total Gate Charge	$Q_g$	$V_{DD} = 10 \text{ V}$ , $V_{GS} = 4.5 \text{ V}$ , $I_S = 13 \text{ A}$	Test Circuit 8	–	48	–	nC
Forward Source-to-Source Voltage	$V_{F(S-S)}$	$I_S = 3 \text{ A}$ , $V_{GS} = 0 \text{ V}$	Test Circuit 6	–	0.76	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.

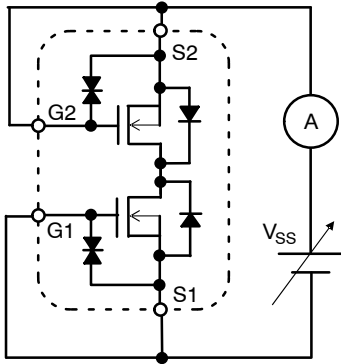


Figure 1. Test Circuit 1 –  $I_{SSS}$

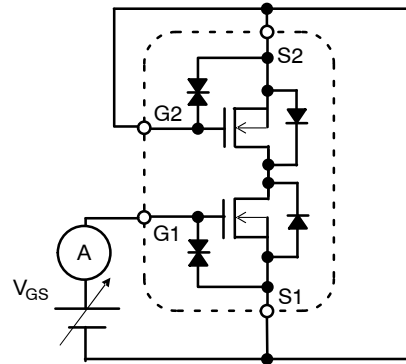


Figure 2. Test Circuit 2 –  $I_{GSS}$

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

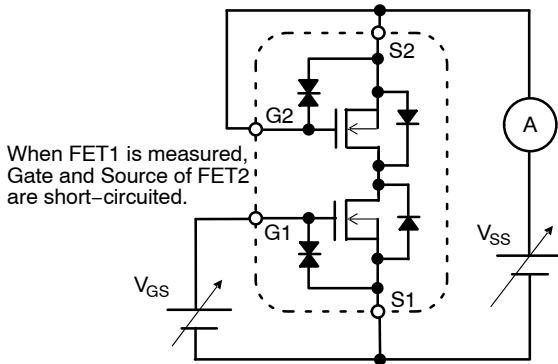


Figure 3. Test Circuit 3 –  $V_{GS(off)}$

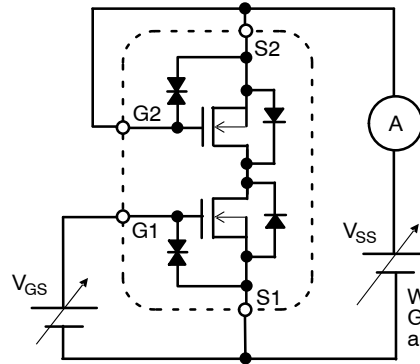


Figure 4. Test Circuit 4 –  $|y_{fs}|$

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

TEST CIRCUITS (continued)

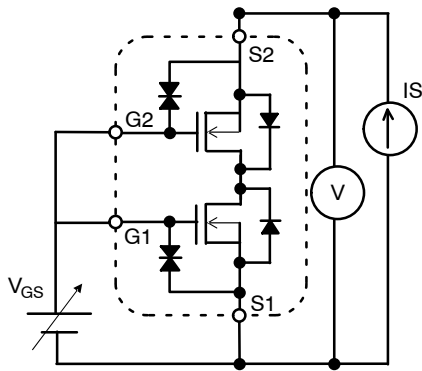
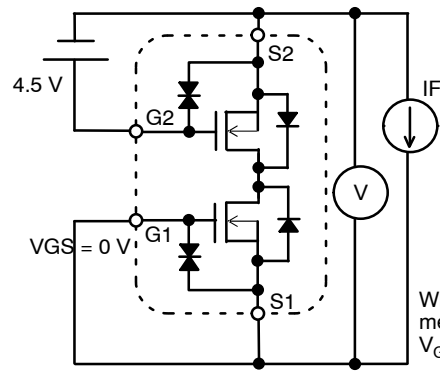


Figure 5. Test Circuit 5 –  $R_{SS(on)}$



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

Figure 6. Test Circuit 6 –  $V_F(S-S)$

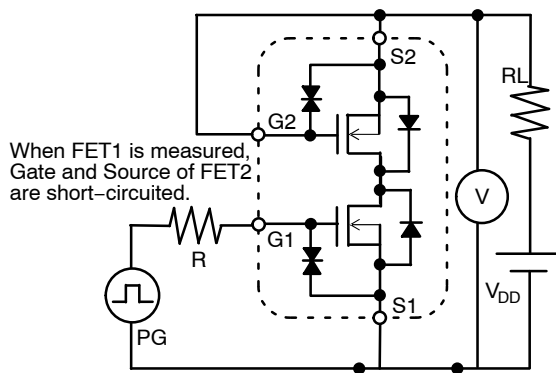


Figure 7. Test Circuit 7 –  $t_d(on)$ ,  $t_r$ ,  $t_d(off)$ ,  $t_f$

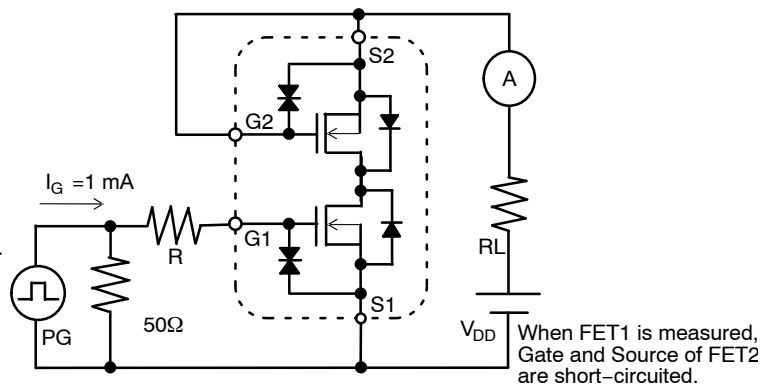


Figure 8. Test Circuit 8 –  $Q_g$

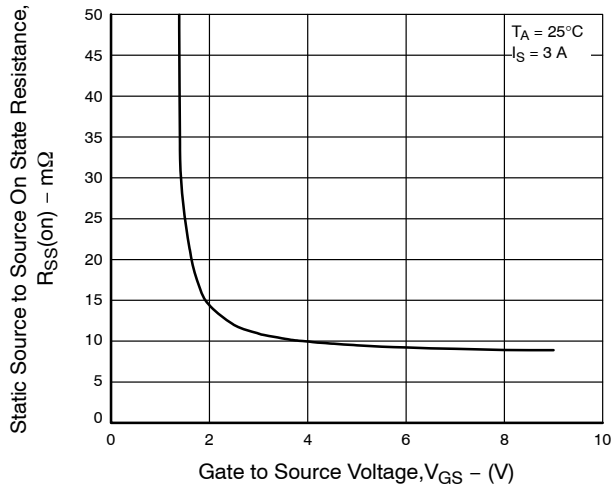


Figure 9.  $R_{SS(on)}$  –  $V_{GS}$

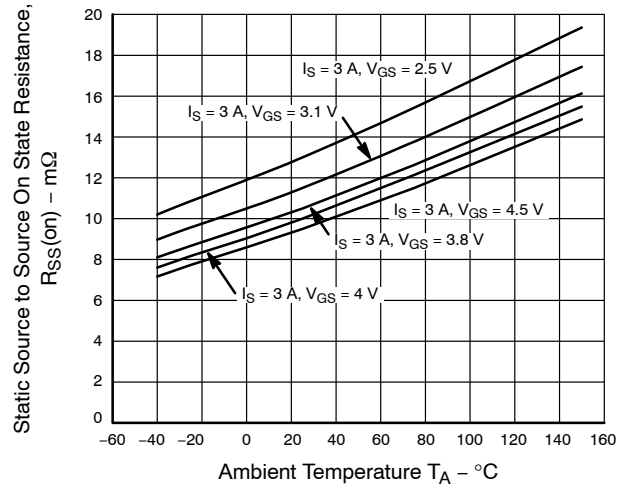


Figure 10.  $R_{SS(on)}$  –  $T_A$

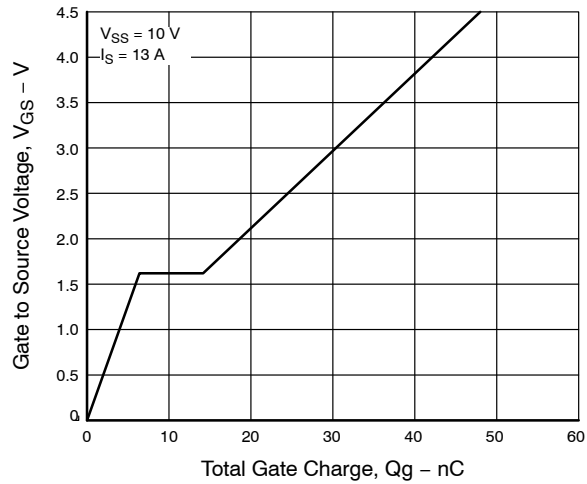


Figure 11.  $Q_g$  –  $V_{GS}$

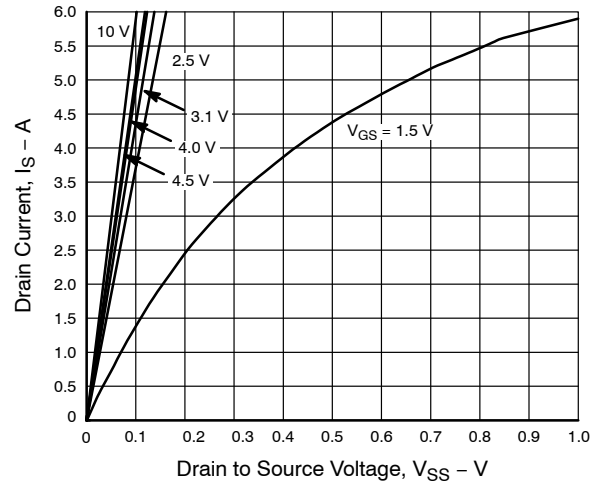


Figure 12.  $I_S$  –  $V_{SS}$

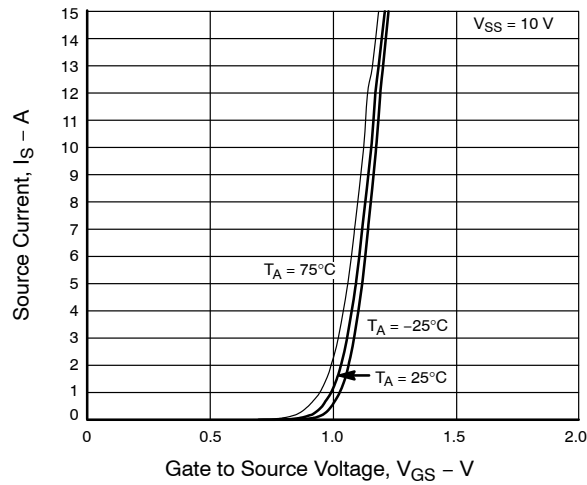


Figure 13.  $I_S$  –  $V_{GS}$

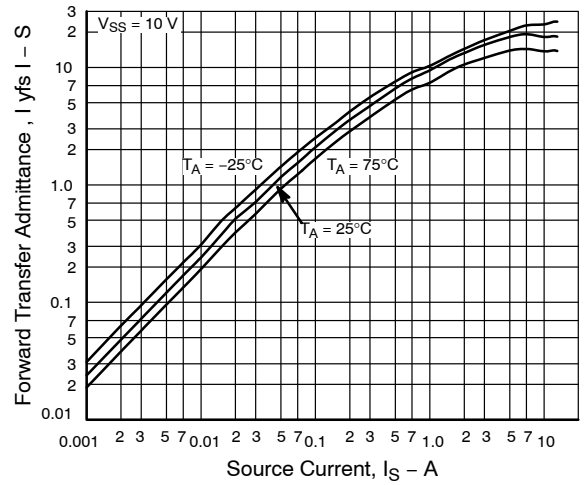


Figure 14.  $|y_{fs}|$  –  $I_S$

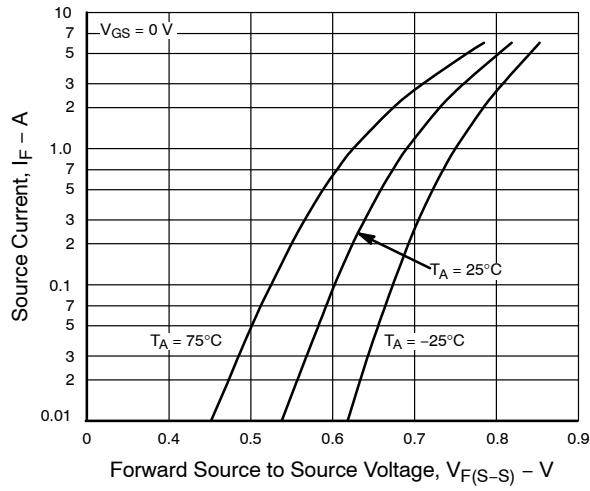


Figure 15.  $I_S - V_{F(S-S)}$

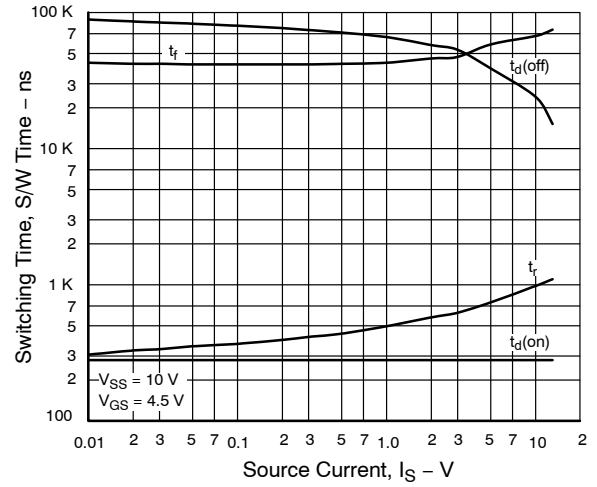


Figure 16. S/W Time -  $I_D$

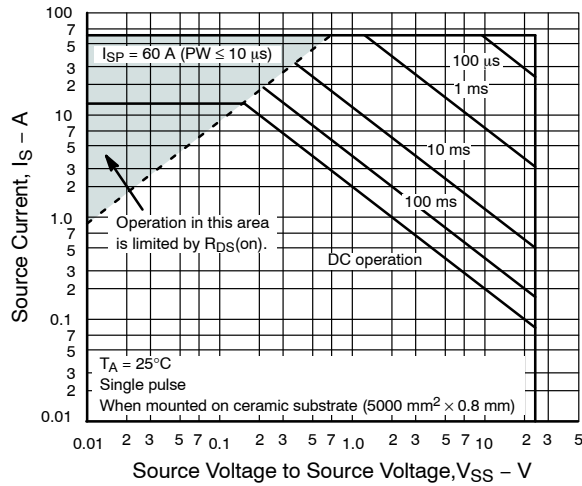


Figure 17. ASO

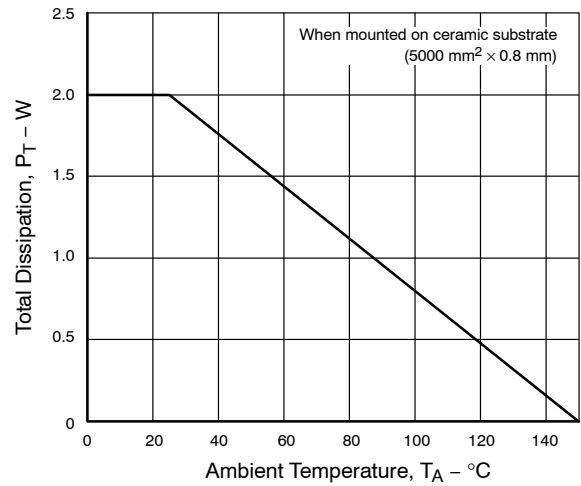


Figure 18.  $P_T - T_A$

Note on usage: Since the EFC6601R is a MOSFET product, please avoid using this device in the vicinity of highly charged objects.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



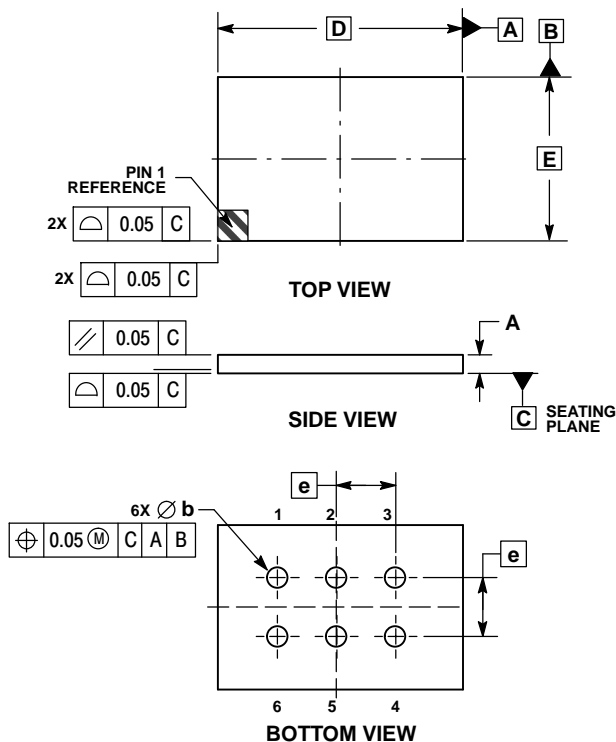
SCALE 4:1

WLCSP6 1.81x2.70 / EFCP2718-6CE-020

CASE 567HS

ISSUE A

DATE 14 NOV 2014

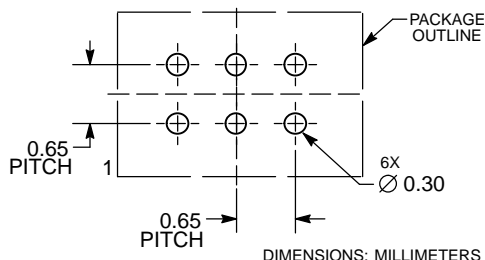


### NOTES:

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

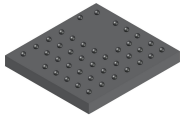
DIM	MILLIMETERS	
	MIN	MAX
A	0.18	0.22
b	0.27	0.33
D	2.70 BSC	
E	1.81 BSC	
e	0.65 BSC	

### RECOMMENDED SOLDERING FOOTPRINT\*

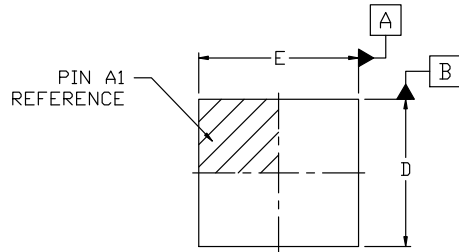


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

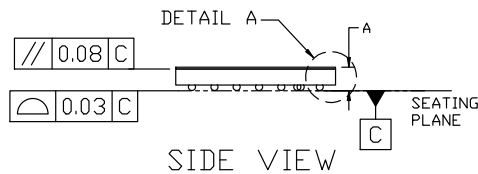
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		PAGE 1 OF 2


**WLCSP40 2.301x2.499x0.369**  
**CASE 567HU**  
**ISSUE O**

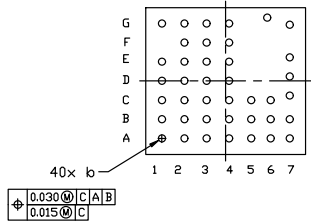
DATE 29 APR 2022



TOP VIEW

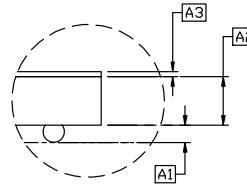
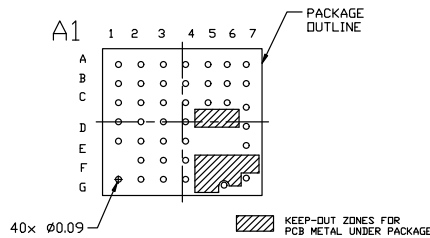


SIDE VIEW



BOTTOM VIEW

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.333	0.369	0.405
A1	0.070	0.090	0.110
A2	0.254 REF		
A3	0.022	0.025	0.028
b	0.096	0.111	0.126
D	2.276	2.301	2.326
E	2.474	2.499	2.524


DETAIL A  
SCALE 1:3

RECOMMENDED  
MOUNTING 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.

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER PARALLEL TO DATUM C.
4. COPLANARITY APPLIES TO THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. DATUM C, THE SEATING PLANE, IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.

BALL POSITION TABLE					
BALL	X	Y	BALL	X	Y
A1	-1.00	-0.90	D1	-1.00	0.00
A2	-0.65	-0.90	D2	-0.65	0.00
A3	-0.30	-0.90	D3	-0.30	0.00
A4	0.05	-0.90	D4	0.05	0.00
A5	0.40	-0.90	D7	1.00	0.07
A6	0.70	-0.90	E1	-1.00	0.30
A7	1.00	-0.90	E2	-0.65	0.30
B1	-1.00	-0.60	E3	-0.30	0.30
B2	-0.65	-0.60	E4	0.05	0.30
B3	-0.30	-0.60	E7	1.00	0.37
B4	0.05	-0.60	F2	-0.65	0.60
B5	0.40	-0.60	F3	-0.30	0.60
B6	0.70	-0.60	F4	0.05	0.60
B7	1.00	-0.60	G1	-1.00	0.90
C1	-1.00	-0.30	G2	-0.65	0.90
C2	-0.65	-0.30	G3	-0.30	0.90
C3	-0.30	-0.30	G4	0.05	0.90
C4	0.05	-0.30	G6	0.65	0.99
C5	0.40	-0.30	G7	1.00	0.88
C6	0.70	-0.30			
C7	1.00	-0.23			

MOUNTING PAD POSITION TABLE					
BALL	X	Y	BALL	X	Y
A1	-1.00	0.90	D1	-1.00	0.00
A2	-0.65	0.90	D2	-0.65	0.00
A3	-0.30	0.90	D3	-0.30	0.00
A4	0.05	0.90	D4	0.05	0.00
A5	0.40	0.90	D7	1.00	-0.07
A6	0.70	0.90	E1	-1.00	-0.30
A7	1.00	0.90	E2	-0.65	-0.30
B1	-1.00	0.60	E3	-0.30	-0.30
B2	-0.65	0.60	E4	0.05	-0.30
B3	-0.30	0.60	E7	1.00	-0.37
B4	0.05	0.60	F2	-0.65	-0.60
B5	0.40	0.60	F3	-0.30	-0.60
B6	0.70	0.60	F4	0.05	-0.60
B7	1.00	0.60	G1	-1.00	-0.90
C1	-1.00	0.30	G2	-0.65	-0.90
C2	-0.65	0.30	G3	-0.30	-0.90
C3	-0.30	0.30	G4	0.05	-0.90
C4	0.05	0.30	G6	0.65	-0.99
C5	0.40	0.30	G7	1.00	-0.88
C6	0.70	0.30			
C7	1.00	0.23			

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