

# L-C LCD and Camera EMI Filter Array with ESD Protection

## CM1693-04DE, CM1693-06DE, CM1693-08DE

### Product Description

The CM1693 is a family of pi-style EMI filter arrays with ESD protection, which integrates four, six or eight filters (C-L-C) into a small-form factor, uDFN 0.40 mm pitch package. Each EMI filter channel is implemented as a 3-pole L-C filter, where the component values are 10 pF–26 nH–12 pF. The CM1693's roll-off frequency at –6 dB attenuation is 300 MHz and can be used in applications where the data rates are as high as 140 Mbps. The CM1693 also provides greater than –30 dB attenuation over the 800 MHz to 6 GHz frequency range. The device includes ESD diodes on every pin that provide a very high level of protection for sensitive electronic components against possible electrostatic discharge (ESD). The ESD protection diodes connected to the filter ports are designed and characterized to safely dissipate ESD strikes of  $\pm 18$  kV, which is beyond the maximum requirement of the IEC61000-4-2 international standard.

This device is particularly well suited for wireless handsets, mobile LCD modules and PDAs because of its small package format and easy-to-use pin assignments. In particular, the CM1693 is ideal for EMI filtering and protecting data and control lines for the LCD display and camera interface in mobile handsets.

The CM1693 is housed in space saving, low profile, 0.40 mm pitch uDFN packages in a RoHS compliant, Pb-Free format.

### Features

- 4, 6 or 8 Channels of EMI Filtering with Integrated ESD Protection
- Pi-Style EMI Filters in a Capacitor–Inductor–Capacitor (C–L–C) Network
- +18 kV ESD Protection on Each Channel (IEC 61000-4-2 Level 4, Contact Discharge)
- Greater than –35 dB Attenuation (Typical) at 1GHz
- uDFN Lead-Free Package with 0.40 mm Lead Pitch:
  - ♦ 4-Ch. = 8-Lead uDFN
  - ♦ 6-Ch. = 12-Lead uDFN
  - ♦ 8-Ch. = 16-Lead uDFN
- uDFN Package size:
  - ♦ 8-Lead: 1.70 mm x 1.35 mm
  - ♦ 12-Lead: 2.50 mm x 1.35 mm
  - ♦ 16-Lead: 3.30 mm x 1.35 mm
- Increased Robustness Against Vertical Impacts During Manufacturing Process
- These Devices are Pb-Free and are RoHS Compliant

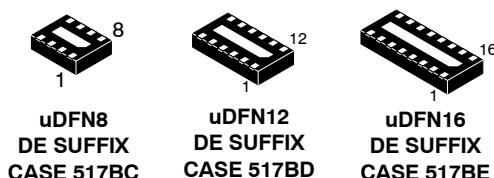
### Applications

- LCD and Camera Data Lines in Mobile Handsets
- I/O Port Protection for Mobile Handsets, Notebook Computers, PDAs etc.
- Handheld PCs/PDAs
- LCD and Camera Modules
- EMI Filtering for Data Ports in Cell Phones, PDAs or Notebook Computers.
- Wireless Handsets

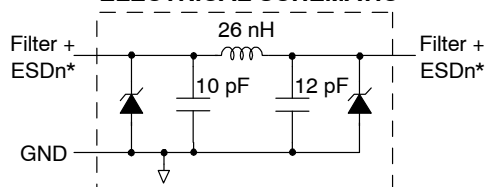


ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)



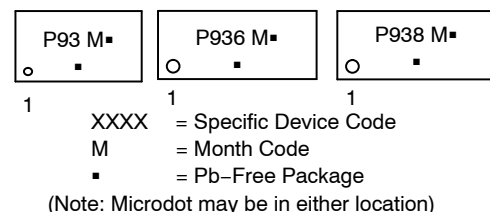
### ELECTRICAL SCHEMATIC



1 of 4, 6 or 8 EMI/RFI Filter Channels  
with Integrated ESD protection

\* See Package/Pinout Diagram for expanded pin information

### MARKING DIAGRAM



### ORDERING INFORMATION

| Device      | Package           | Shipping†        |
|-------------|-------------------|------------------|
| CM1693-04DE | uDFN-8 (Pb-Free)  | 3000/Tape & Reel |
| CM1693-06DE | uDFN-12 (Pb-Free) | 3000/Tape & Reel |
| CM1693-08DE | uDFN-16 (Pb-Free) | 3000/Tape & Reel |

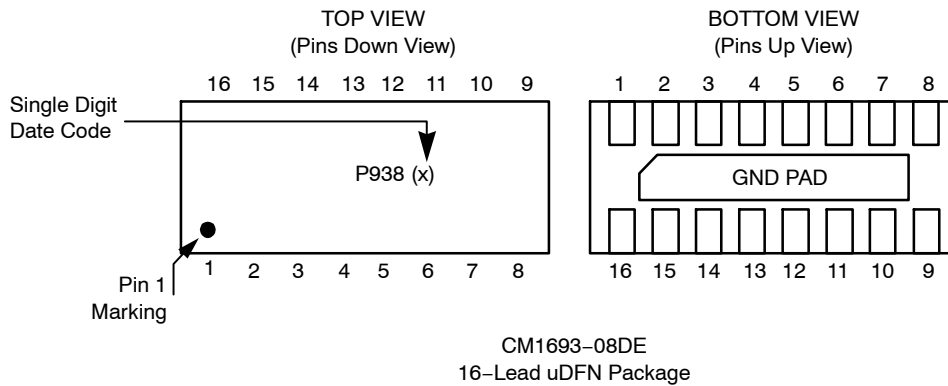
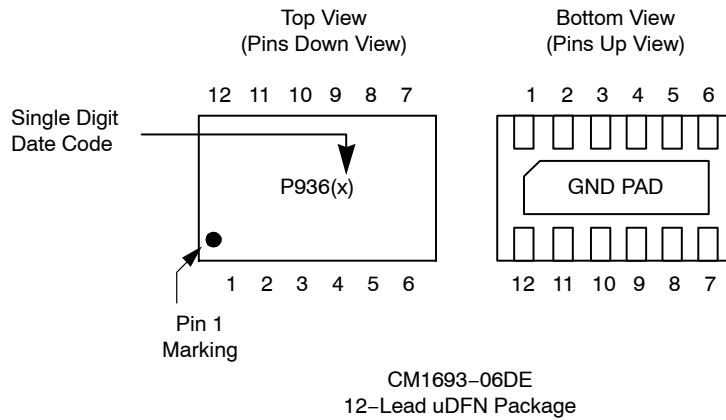
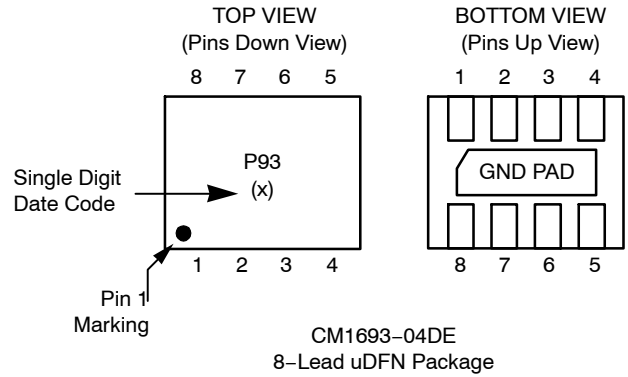
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# CM1693-04DE, CM1693-06DE, CM1693-08DE

**Table 1. PIN DESCRIPTIONS**

| Device Pin(s) |       |       | Name    | Description            |
|---------------|-------|-------|---------|------------------------|
| -04           | -06   | -08   |         |                        |
| 1; 8          | 1; 12 | 1; 16 | FILTER1 | Filter + ESD Channel 1 |
| 2; 7          | 2; 11 | 2; 15 | FILTER2 | Filter + ESD Channel 2 |
| 3; 6          | 3; 10 | 3; 14 | FILTER3 | Filter + ESD Channel 3 |
| 4; 5          | 4; 9  | 4; 13 | FILTER4 | Filter + ESD Channel 4 |
|               | 5; 8  | 5; 12 | FILTER5 | Filter + ESD Channel 5 |
|               | 6; 7  | 6; 11 | FILTER6 | Filter + ESD Channel 6 |
|               |       | 7; 10 | FILTER7 | Filter + ESD Channel 7 |
|               |       | 8; 9  | FILTER8 | Filter + ESD Channel 8 |
| GND PAD       |       |       | GND     | Device Ground          |

**PACKAGE / PINOUT DIAGRAMS**



## SPECIFICATIONS

Table 2. ABSOLUTE MAXIMUM RATINGS

| Parameter                 | Rating      | Units |
|---------------------------|-------------|-------|
| Storage Temperature Range | -65 to +150 | °C    |
| Current per Inductor      | 30          | mA    |
| DC Package Power Rating   | 500         | mW    |

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.

Table 3. STANDARD OPERATING CONDITIONS

| Parameter                   | Rating     | Units |
|-----------------------------|------------|-------|
| Operating Temperature Range | -40 to +85 | °C    |

Table 4. ELECTRICAL OPERATING CHARACTERISTICS (Note 1)

| Symbol             | Parameter                                                                                                      | Conditions                                              | Min         | Typ         | Max         | Units    |
|--------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-------------|-------------|-------------|----------|
| L                  | Channel Inductance                                                                                             |                                                         |             | 26          |             | nH       |
| C <sub>TOTAL</sub> | Total Channel Capacitance (Note 4)                                                                             | At 2.5 VDC Reverse Bias,<br>1 MHz, 30 mVAC              | 17.6        | 22          | 26.4        | pF       |
| V <sub>DIODE</sub> | Standoff Voltage                                                                                               | I <sub>DIODE</sub> = 10 $\mu$ A                         | 5.5         |             |             | V        |
| I <sub>LEAK</sub>  | Diode Leakage Current (reverse bias)                                                                           | V <sub>DIODE</sub> = +3.3 V                             |             | 0.1         | 1.0         | $\mu$ A  |
| V <sub>SIG</sub>   | Signal Clamp Voltage<br>Positive Clamp<br>Negative Clamp                                                       | I <sub>LOAD</sub> = 10 mA<br>I <sub>LOAD</sub> = -10 mA | 5.6<br>-1.5 | 6.8<br>-0.8 | 9.0<br>-0.4 | V        |
| V <sub>ESD</sub>   | In-system ESD Withstand Voltage<br>Contact Discharge per IEC 61000-4-2 Level 4                                 | (Notes 2, 3 and 4)                                      | $\pm 18$    |             |             | kV       |
| R <sub>DYN</sub>   | Dynamic Resistance<br>Positive<br>Negative                                                                     |                                                         |             | 2.3<br>0.9  |             | $\Omega$ |
| f <sub>R</sub>     | Roll-off Frequency at -6 dB Attenuation<br>Z <sub>SOURCE</sub> = 50 $\Omega$ , Z <sub>LOAD</sub> = 50 $\Omega$ |                                                         |             | 300         |             | MHz      |

1. T<sub>A</sub> = 25°C unless otherwise specified.
2. ESD applied to input and output pins with respect to GND, one at a time.
3. Clamping voltage is measured at the opposite side of the EMI filter to the ESD pin (i.e. if ESD is applied to pin A1 then clamping voltage is measured at pin C1). Unused pins are left open.
4. These parameters are guaranteed by design and characterization.

PERFORMANCE INFORMATION

Typical Filter Performance ( $T_A = 25^\circ\text{C}$ , DC Bias = 0 V, 50 Ohm Environment)

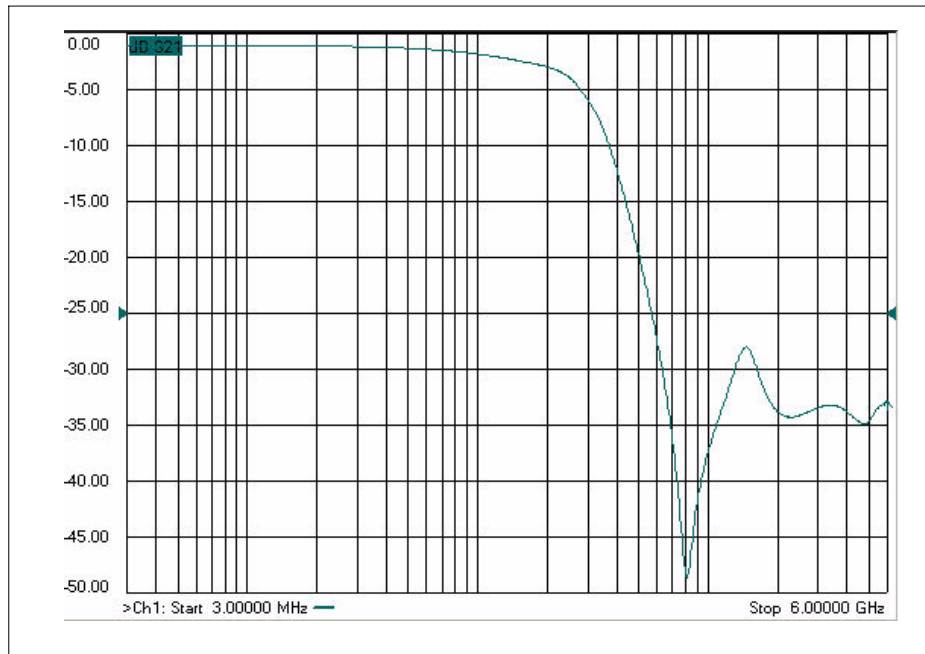


Figure 1. Typical Filter Insertion Loss (CM1693)

Typical Diode Capacitance vs. Input Voltage

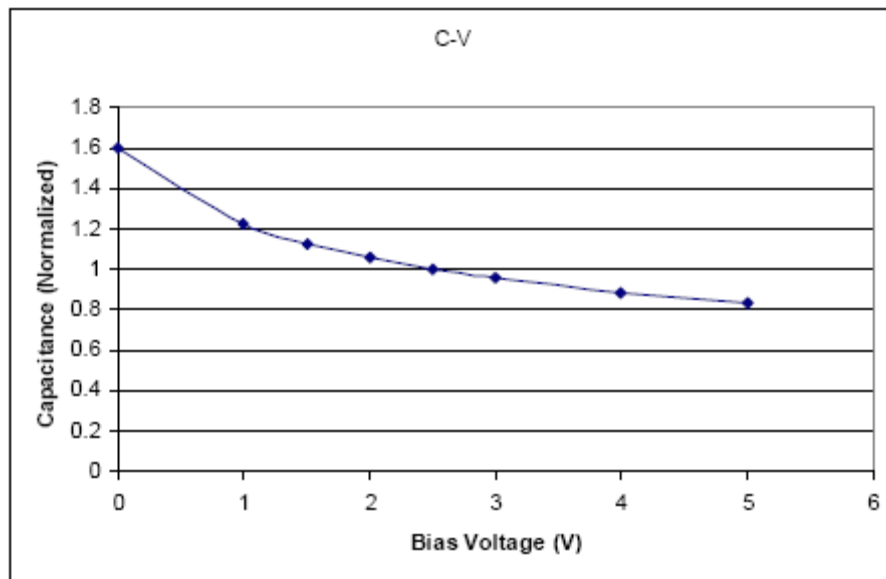


Figure 2. Filter Capacitance vs. Input Voltage  
(Normalized to Capacitance at 0 VDC and  $25^\circ\text{C}$ )

## MECHANICAL DETAILS

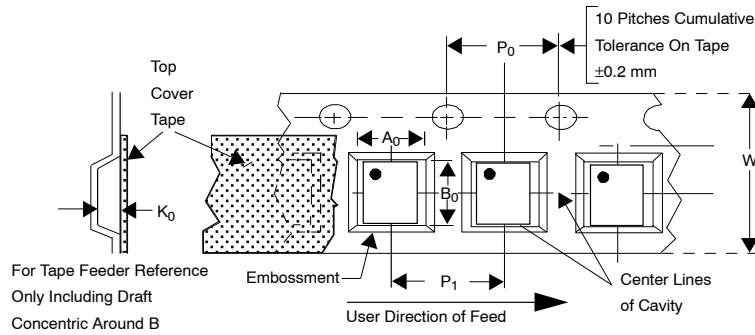
### uDFN-08, uDFN-12 and uDFN-16 Mechanical Specifications, 0.4mm

The 8-lead, 12-lead and 16-lead, 0.4 mm pitch uDFN package dimensions are presented below.

**Table 5. TAPE AND REEL SPECIFICATIONS**

| Part Number | Package Size (mm)  | Pocket Size (mm)<br>$B_0 \times A_0 \times K_0$ | Tape Width <sup>†</sup><br>W | Reel<br>Diameter | Qty per<br>Reel | P <sub>0</sub> | P <sub>1</sub> |
|-------------|--------------------|-------------------------------------------------|------------------------------|------------------|-----------------|----------------|----------------|
| CM1693-04DE | 1.70 x 1.35 x 0.50 | 1.95 x 1.60 x 0.60                              | 8 mm                         | 178 mm (7")      | 3000            | 4 mm           | 4 mm           |
| CM1693-06DE | 2.50 x 1.35 x 0.50 | 2.75 x 1.60 x 0.60                              | 8 mm                         | 178 mm (7")      | 3000            | 4 mm           | 4 mm           |
| CM1693-08DE | 3.30 x 1.35 x 0.50 | 3.50 x 1.55 x 0.70                              | 12 mm                        | 178 mm (7")      | 3000            | 4 mm           | 4 mm           |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

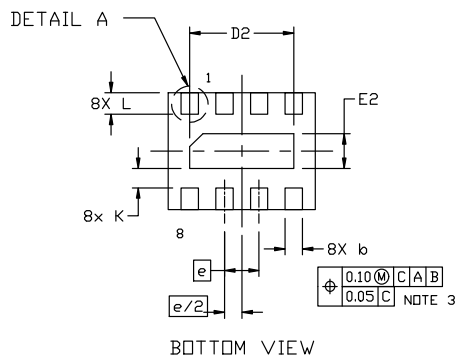
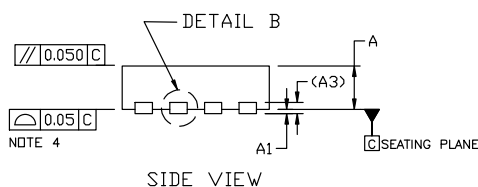
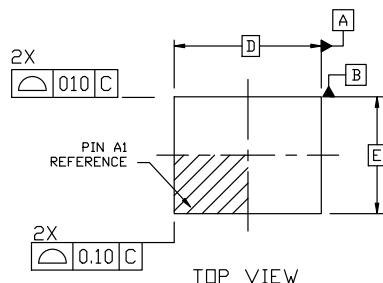




SCALE 4:1

**UDFN8, 1.7x1.35, 0.4P**  
**CASE 517BC**  
**ISSUE A**

DATE 11 AUG 2022


**GENERIC MARKING DIAGRAMS\***

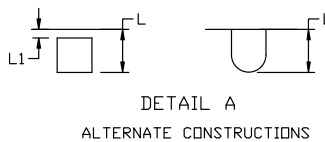
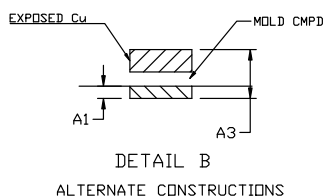

XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

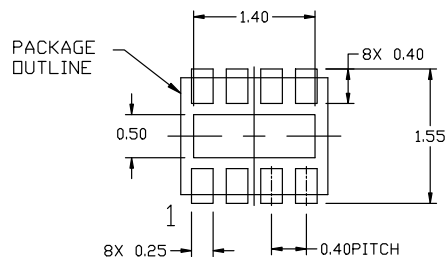
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2004.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.25MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.



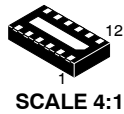
| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN.        | MAX. |
| A   | 0.45        | 0.55 |
| A1  | 0.00        | 0.05 |
| A3  | 0.13 REF    |      |
| b   | 0.15        | 0.25 |
| D   | 1.70 BSC    |      |
| D2  | 1.10        | 1.30 |
| E   | 1.35 BSC    |      |
| E2  | 0.30        | 0.50 |
| e   | 0.40 BSC    |      |
| K   | 0.15        | ---  |
| L   | 0.20        | 0.30 |
| L1  | ---         | 0.05 |


**RECOMMENDED MOUNTING FOOTPRINT\***

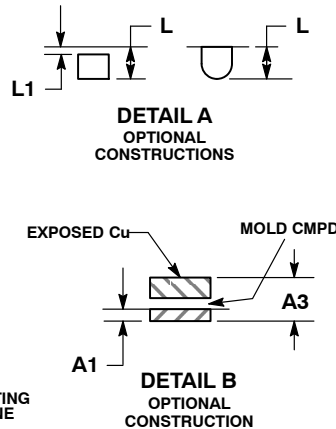
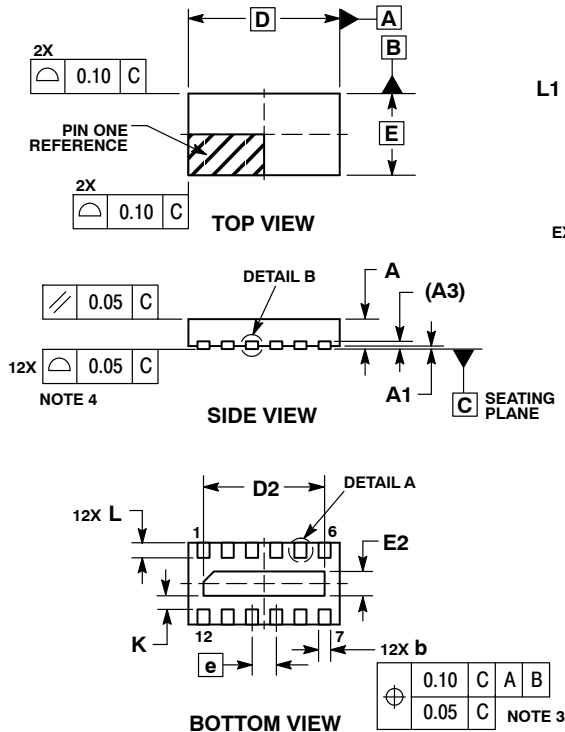
\* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

|                         |                              |                                                                                                                                                                                  |
|-------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98AON47060E</b>           | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>UDFN8, 1.7x1.35, 0.4P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

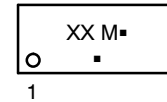

**UDFN12, 2.5x1.35, 0.4P**  
**CASE 517BD**  
**ISSUE O**

DATE 18 NOV 2009



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION  $b$  APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.25 mm FROM THE TERMINAL TIP.
  4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | MIN  | MAX  |
| A           | 0.45 | 0.55 |
| A1          | 0.00 | 0.05 |
| A3          | 0.13 | REF  |
| b           | 0.15 | 0.25 |
| D           | 2.50 | BSC  |
| D2          | 1.90 | 2.10 |
| E           | 1.35 | BSC  |
| E2          | 0.30 | 0.50 |
| e           | 0.40 | BSC  |
| K           | 0.15 | ---  |
| L           | 0.20 | 0.30 |
| L1          | ---  | 0.05 |

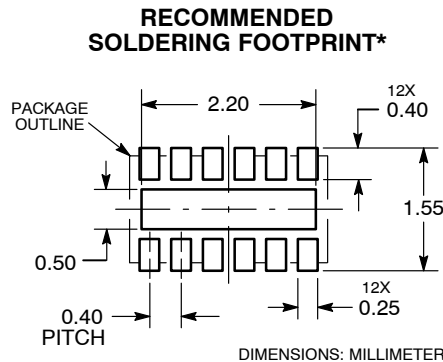
**GENERIC MARKING DIAGRAM\***


- XX = Specific Device Code
- M = Month Code
- = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking.

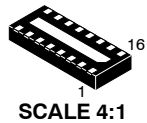
Pb-Free indicator, "G" or microdot "■", may or may not be present.



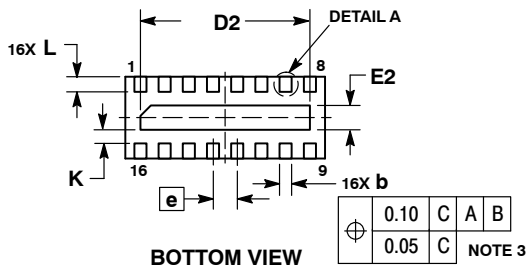
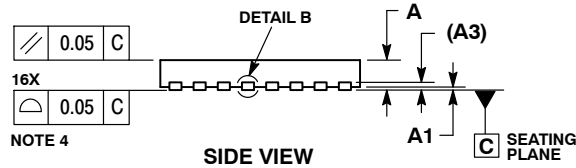
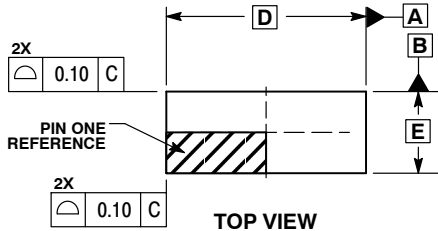
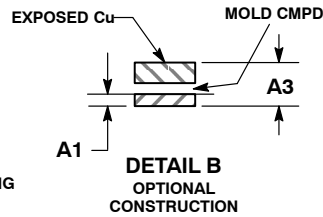
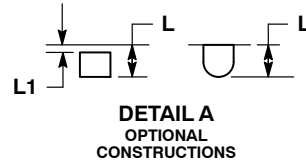
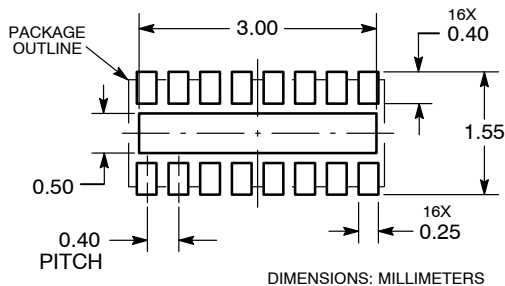
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

|                         |                               |                                                                                                                                                                                  |
|-------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98AON47061E</b>            | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>uDFN12, 2.5x1.35, 0.4p</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

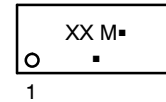

**UDFN16, 3.3x1.35, 0.4P**  
CASE 517BE  
ISSUE O

DATE 18 NOV 2009


**RECOMMENDED  
SOLDERING FOOTPRINT\***


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.25 mm FROM THE TERMINAL TIP.
  4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | MIN  | MAX  |
| A           | 0.45 | 0.55 |
| A1          | 0.00 | 0.05 |
| A3          | 0.13 | REF  |
| b           | 0.15 | 0.25 |
| D           | 3.30 | BSC  |
| D2          | 2.70 | 2.90 |
| E           | 1.35 | BSC  |
| E2          | 0.30 | 0.50 |
| e           | 0.40 | BSC  |
| K           | 0.15 | ---  |
| L           | 0.20 | 0.30 |
| L1          | ---  | 0.05 |

**GENERIC  
MARKING DIAGRAM\***


- XX = Specific Device Code  
M = Month Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*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.

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

|                         |                               |                                                                                                                                                                                     |
|-------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98AON47062E</b>            | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>UDFN16, 3.3X1.35, 0.4P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)