



### Features

- Six or eight channels of EMI filtering with integrated ESD protection
- Pi-style EMI filters in a capacitor-resistor-capacitor (C-R-C) network
- $\pm 15\text{kV}$  ESD protection on each channel (IEC 61000-4-2 Level 4, contact discharge)
- $\pm 30\text{kV}$  ESD protection on each channel (HBM)
- Greater than -35dB attenuation (typical) at 1 GHz
- TDFN package with 0.50mm lead pitch:
  - 6-ch. = 12-lead TDFN
  - 8-ch. = 16-lead TDFN
- Tiny TDFN package size:
  - 12-lead: 3.0mm x 1.35mm
  - 16-lead: 4.0mm x 1.60mm
- Increased robustness against vertical impacts during manufacturing process
- RoHS-compliant, lead-free finishing

### Applications

- LCD and Camera data lines in mobile handsets
- I/O port protection for mobile handsets, notebook computers, PDAs etc.
- EMI filtering for data ports in cell phones, PDAs or notebook computers.
- Wireless handsets
- Handheld PCs/PDAs
- LCD and camera modules

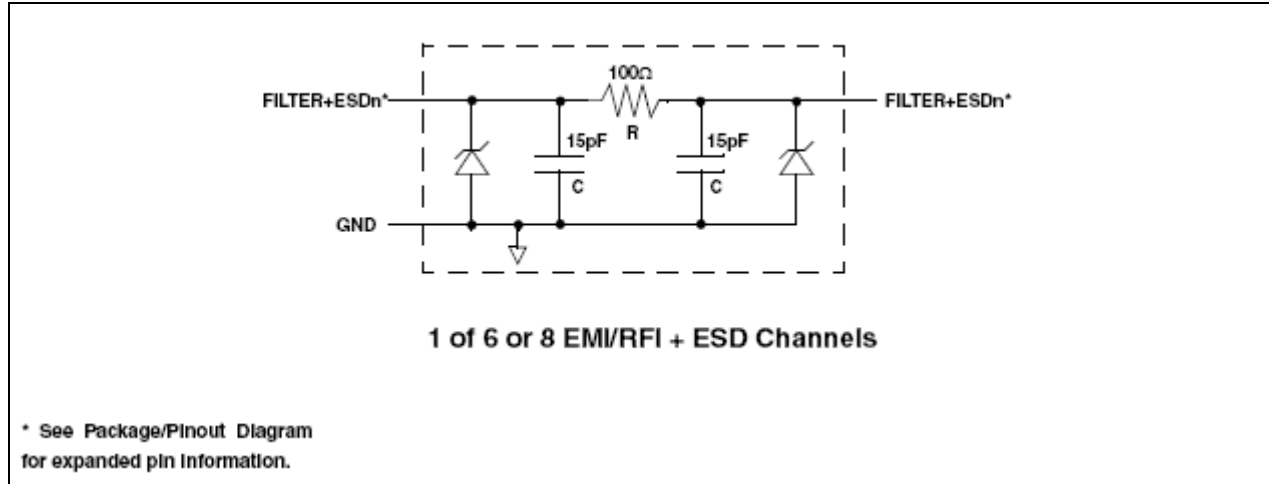
### Product Description

The CM1409 is a family of pi-style EMI filter arrays with ESD protection, which integrates either six or eight filters (C-R-C) in a small form factor, TDFN 0.50mm pitch package. The CM1409 has component values of 15pF-100 $\Omega$ -15pF per channel. The CM1409 has a cut-off frequency of 110MHz and can be used in applications with data rates up to 44Mbps. The parts include ESD diodes on every pin, which provide a very high level of protection for sensitive electronic components against electrostatic discharge (ESD). The ESD protected diodes safely dissipate ESD strikes of  $\pm 15\text{kV}$ , which even exceeds the maximum requirement of the IEC61000-4-2 international standard. Using the MIL-STD-883 (Method 3015) specification for Human Body Model (HBM) ESD, the pins are protected for contact discharges at greater than  $\pm 30\text{kV}$ .

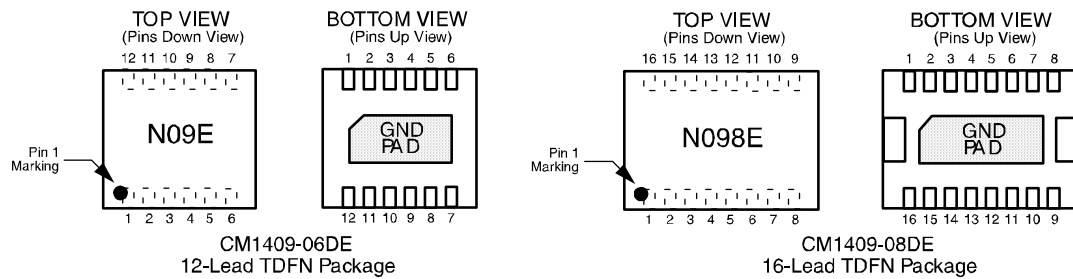
These devices are particularly well-suited for portable electronics (e.g. wireless handsets, PDAs, notebook computers) because of their small package and easy-to-use pin assignments. In particular, the CM1409 is ideal for EMI filtering and protecting data and control lines for the I/O data ports, LCD display and camera interface in mobile handsets.

The CM1409 is housed in space-saving, low-profile 12- and 16-lead TDFN packages with a 0.50mm pitch, RoHS-compliant, lead-free finishing.

## Block Diagram



## PACKAGE / PINOUT DIAGRAMS



Note:  
1) These drawings are not to scale.

# CM1409

## PIN DESCRIPTIONS

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

## Ordering Information

### PART NUMBERING INFORMATION

| Pins | Package | Lead-free Finish                  |              |
|------|---------|-----------------------------------|--------------|
|      |         | Ordering Part Number <sup>1</sup> | Part Marking |
| 12   | TDFN-12 | CM1409-06DE                       | N09E         |
| 16   | TDFN-16 | CM1409-08DE                       | N098E        |

Note 1: Parts are shipped in Tape & Reel form unless otherwise specified.

## Specifications

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                 | RATING      | UNITS |
|---------------------------|-------------|-------|
| Storage Temperature Range | -65 to +150 | °C    |
| DC Power per Resistor     | 100         | mW    |
| DC Package Power Rating   | 500         | mW    |

### STANDARD OPERATING CONDITIONS

| PARAMETER                   | RATING     | UNITS |
|-----------------------------|------------|-------|
| Operating Temperature Range | -40 to +85 | °C    |

**ELECTRICAL OPERATING CHARACTERISTICS** (SEE NOTE1)

| SYMBOL                     | PARAMETER  | CONDITIONS   | MIN                  | TYP         | MAX         | UNITS                |
|----------------------------|--|--|----------------------|-------------|-------------|----------------------|
| R                          | Resistance   |  | 80                   | 100         | 120         | $\Omega$             |
| C <sub>TOTAL</sub>         | Total Channel Capacitance  | At 2.5VDC Reverse Bias, 1MHz, 30mVAC   | 24                   | 30          | 36          | pF                   |
| C                          | Capacitance C <sub>1</sub>   | At 2.5VDC Reverse Bias, 1MHz, 30mVAC   |                      | 15          |             | pF                   |
| V <sub>DIODE</sub>         | Standoff Voltage   | I <sub>DIODE</sub> =10 $\mu$ A   |                      | 6.0         |             | V                    |
| I <sub>LEAK</sub>          | Diode Leakage Current (reverse bias)   | V <sub>DIODE</sub> = 3.3V  |                      | 0.1         | 1.0         | $\mu$ A              |
| V <sub>SIG</sub>           | Signal Clamp Voltage<br>Positive Clamp<br>Negative Clamp   | I <sub>LOAD</sub> = 10mA<br>I <sub>LOAD</sub> = -10mA  | 5.6<br>-1.5          | 6.8<br>-0.8 | 9.0<br>-0.4 | V<br>V               |
| V <sub>ESD</sub>           | In-system ESD Withstand Voltage<br>a) Human Body Model, MIL-STD-883, Method 3015<br>b) Contact Discharge per IEC 61000-4-2 Level 4 | Note 2   | $\pm$ 30<br>$\pm$ 15 |             |             | kV<br>kV             |
| R <sub>DYN</sub>           | Dynamic Resistance<br>Positive<br>Negative   |  |                      | 2.3<br>0.9  |             | $\Omega$<br>$\Omega$ |
| f <sub>c</sub>             | Cut-off Frequency<br>Z <sub>SOURCE</sub> =50 $\Omega$ , Z <sub>LOAD</sub> =50 $\Omega$   | Channel R = 100 $\Omega$ ,<br>Channel C = 15pF   |                      | 110         |             | MHz                  |
| A <sub>1GHz</sub>          | Absolute Attenuation @ 1GHz from 0dB Level   | Z <sub>SOURCE</sub> = 50 $\Omega$ , Z <sub>LOAD</sub> = 50 $\Omega$ ,<br>DC Bias = 0V; Notes 1 and 3 |                      | 35          |             | dB                   |
| A <sub>800MHz - 6GHz</sub> | Absolute Attenuation @ 800MHz to 6GHz from 0dB Level   | Z <sub>SOURCE</sub> = 50 $\Omega$ , Z <sub>LOAD</sub> = 50 $\Omega$ ,<br>DC Bias = 0V; Notes 1 and 3 |                      | 30          |             | dB                   |

Note 1: T<sub>A</sub>=25°C unless otherwise specified.

Note 2: ESD applied to input and output pins with respect to GND, one at a time.

Note 3: Attenuation / RF curves characterized by a network analyzer using microprobes.

## Performance Information

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

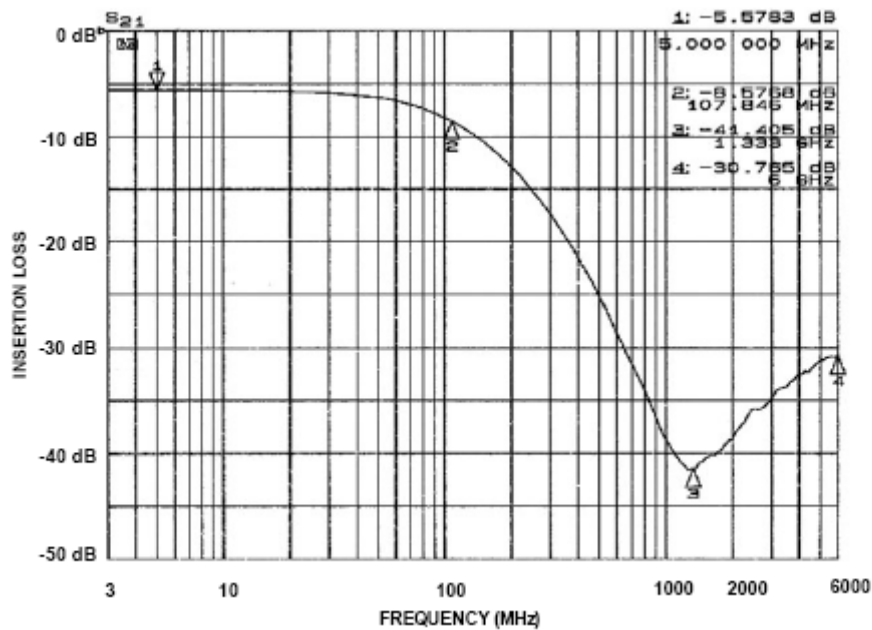


Figure 1. Insertion Loss vs. Frequency (FILTER1 Input to GND)

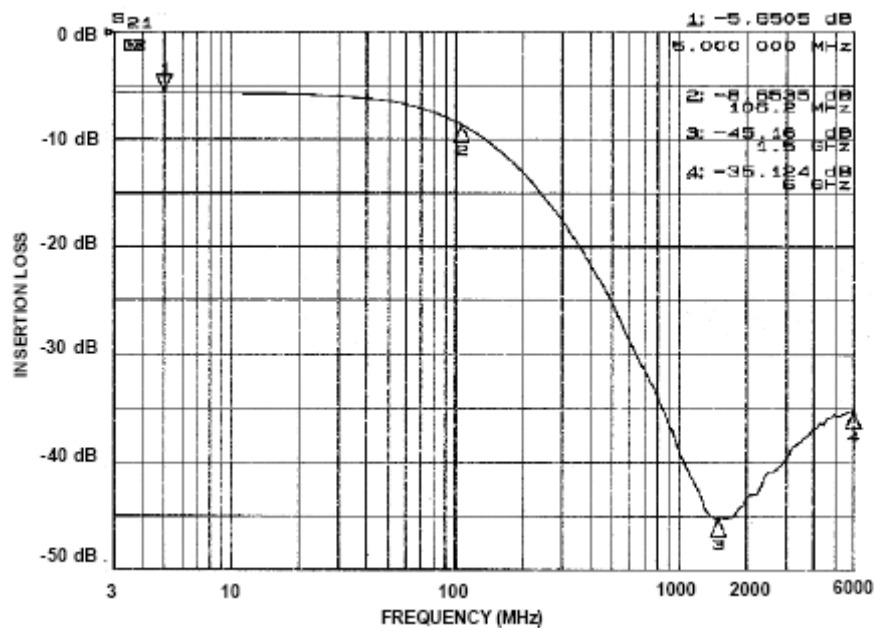


Figure 2. Insertion Loss vs. Frequency (FILTER2 Input to GND)

Performance Information (cont'd)

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

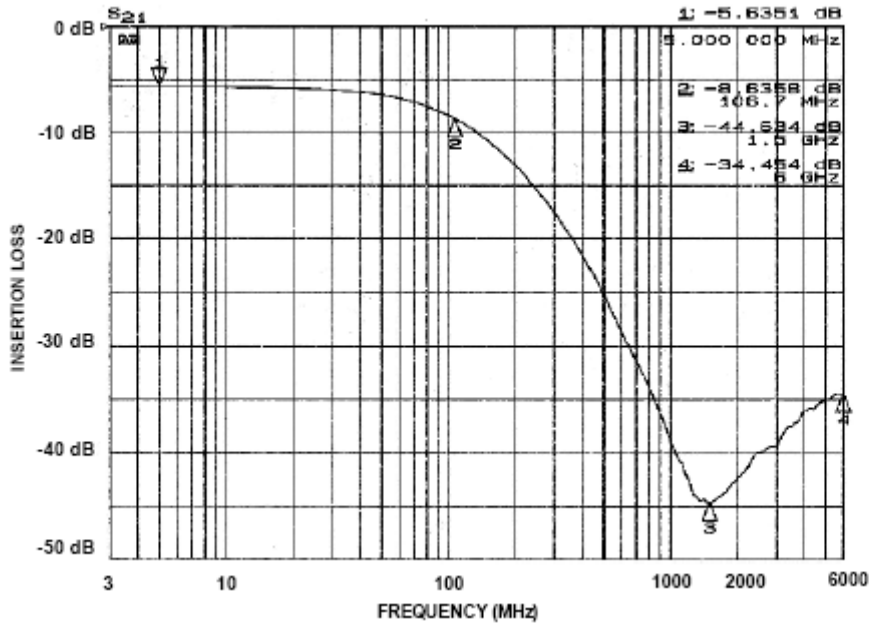


Figure 3. Insertion Loss vs. Frequency (FILTER3 Input to GND)

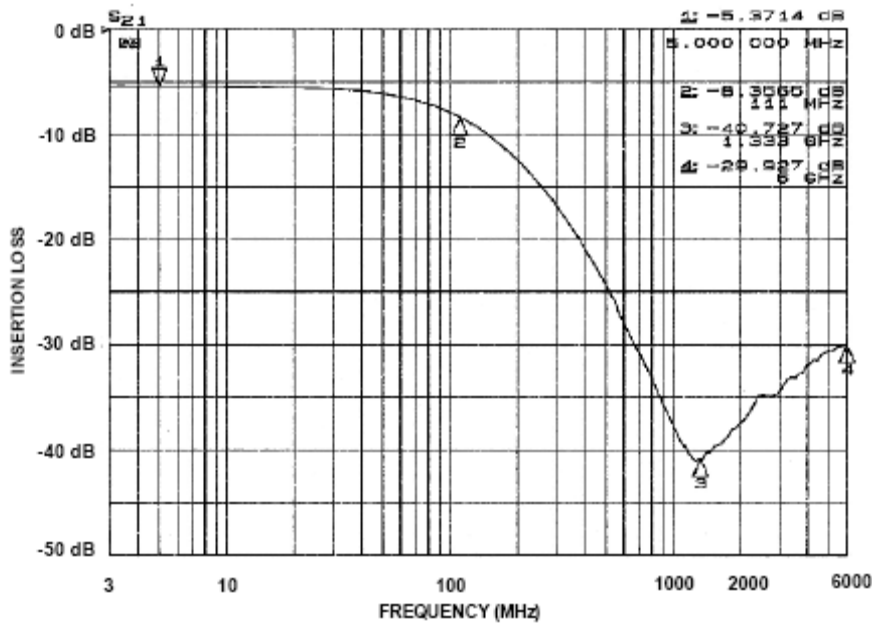


Figure 4. Insertion Loss vs. Frequency (FILTER4 Input to GND)

Performance Information (cont'd)

Typical Diode Capacitance vs. Input Voltage

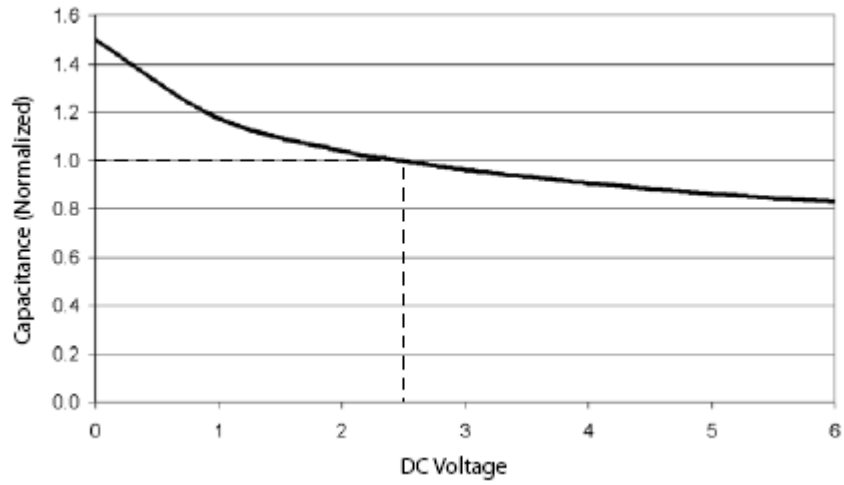


Figure 5. Filter Capacitance vs. Input Voltage (normalized to capacitance at 2.5VDC and 25°C)



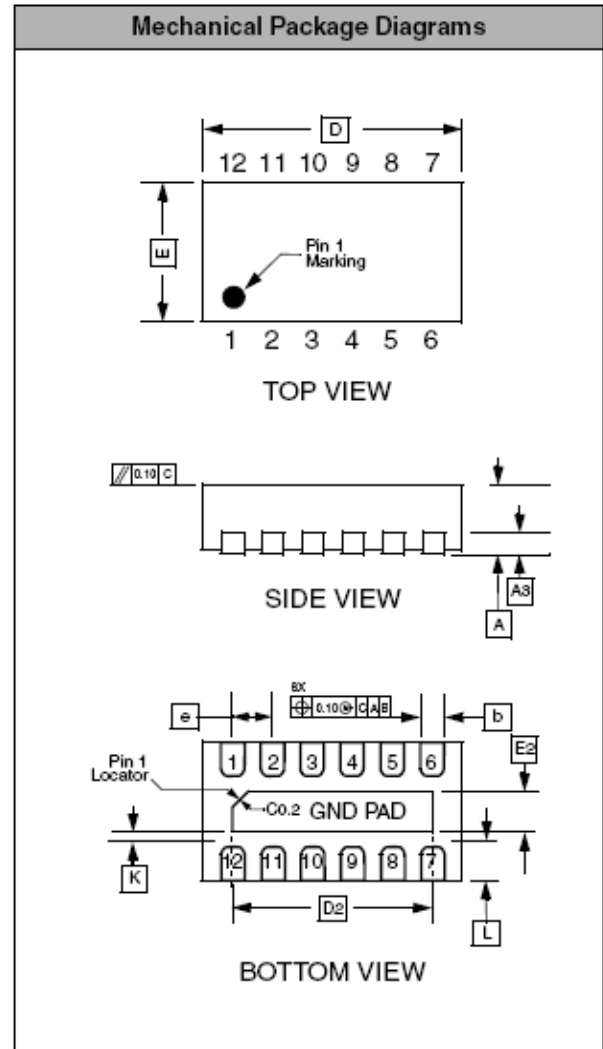
# CM1409

## Mechanical Details

### TDFN-12 Mechanical Specifications

The CM1409-06DE is supplied in a 12-lead, 0.5mm pitch TDFN package. Dimensions are presented below.

| PACKAGE DIMENSIONS                 |             |      |      |           |       |       |
|------------------------------------|-------------|------|------|-----------|-------|-------|
| Package                            | TDFN        |      |      |           |       |       |
| JEDEC No.                          | MO-229C     |      |      |           |       |       |
| Leads                              | 12          |      |      |           |       |       |
| Dim.                               | Millimeters |      |      | Inches    |       |       |
|                                    | Min         | Nom  | Max  | Min       | Nom   | Max   |
| A                                  | 0.70        | 0.75 | 0.80 | 0.028     | 0.030 | 0.031 |
| A3                                 | 0.20 REF    |      |      | 0.008 REF |       |       |
| b                                  | 0.20        | 0.25 | 0.30 | 0.008     | 0.010 | 0.012 |
| D                                  | 2.90        | 3.00 | 3.10 | 0.114     | 0.118 | 0.122 |
| D2                                 | 2.40        | 2.50 | 2.60 | 0.095     | 0.098 | 0.102 |
| E                                  | 1.25        | 1.35 | 1.45 | 0.049     | 0.053 | 0.057 |
| E2                                 | 0.35        | 0.40 | 0.45 | 0.014     | 0.016 | 0.018 |
| e                                  | 0.50 BSC    |      |      | 0.020 BSC |       |       |
| K                                  | 0.20        |      |      | 0.008     |       |       |
| L                                  | 0.20        | 0.25 | 0.30 | 0.008     | 0.010 | 0.012 |
| # per tape and reel                | 3000 pieces |      |      |           |       |       |
| Controlling dimension: millimeters |             |      |      |           |       |       |

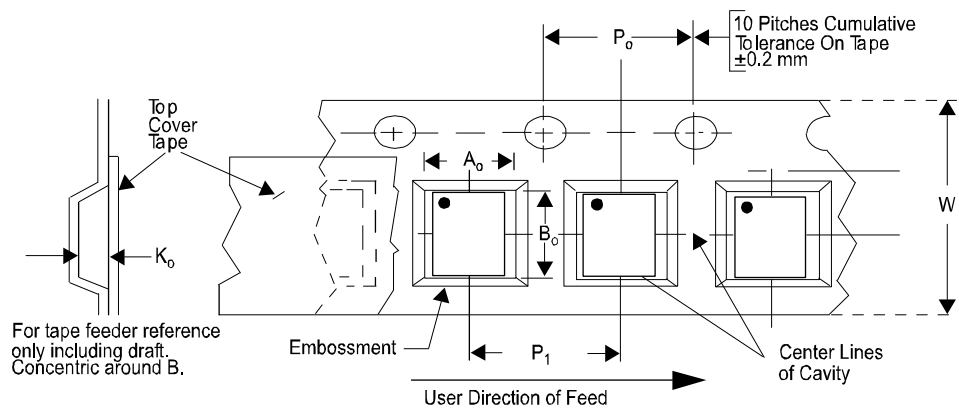


Dimensions for 12-Lead, 0.5mm pitch TDFN package

This package is compliant with JEDEC standard MO-229C with the exception of the "D", "D2", "E", "E2", "K" and "L" dimensions as called out in the table above.

**Tape and Reel Specifications**

| PART NUMBER | PACKAGE SIZE (mm)  | POCKET SIZE (mm)<br>$B_o \times A_o \times K_o$ | TAPE WIDTH<br>W | REEL DIAMETER | QTY PER REEL | $P_o$ | $P_1$ |
|-------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1409-06DE | 3.00 X 1.35 X 0.75 | 3.30 X 1.65 X 1.05                              | 8mm             | 178mm (7")    | 3000         | 4mm   | 4mm   |



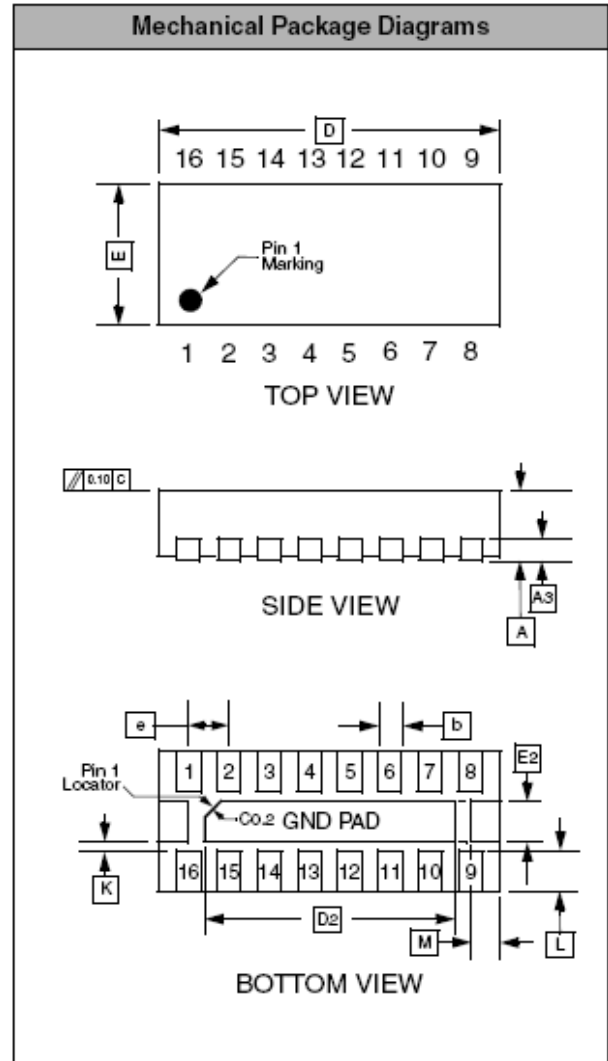
# CM1409

## Mechanical Details (cont'd)

### TDFN-16 Mechanical Specifications

The CM1409-08DE is supplied in a 16-lead, 0.5mm pitch TDFN package. Dimensions are presented below.

| PACKAGE DIMENSIONS                 |             |      |      |           |       |       |
|------------------------------------|-------------|------|------|-----------|-------|-------|
| Package                            | TDFN        |      |      |           |       |       |
| JEDEC No.                          | MO-229C     |      |      |           |       |       |
| Leads                              | 16          |      |      |           |       |       |
| Dim.                               | Millimeters |      |      | Inches    |       |       |
|                                    | Min         | Nom  | Max  | Min       | Nom   | Max   |
| A                                  | 0.70        | 0.75 | 0.80 | 0.028     | 0.030 | 0.031 |
| A3                                 | 0.20 REF    |      |      | 0.008 REF |       |       |
| b                                  | 0.20        | 0.25 | 0.30 | 0.008     | 0.010 | 0.012 |
| D                                  | 3.90        | 4.00 | 4.10 | 0.153     | 0.157 | 0.161 |
| D2                                 | 3.10        | 3.20 | 3.30 | 0.122     | 0.126 | 0.130 |
| E                                  | 1.50        | 1.60 | 1.70 | 0.059     | 0.063 | 0.067 |
| E2                                 | 0.30        | 0.40 | 0.50 | 0.012     | 0.016 | 0.020 |
| e                                  | 0.50 BSC    |      |      | 0.020 BSC |       |       |
| K                                  | 0.20        |      |      | 0.008     |       |       |
| L                                  | 0.20        | 0.30 | 0.40 | 0.008     | 0.010 | 0.012 |
| M                                  | 0.25 REF    |      |      | 0.010 REF |       |       |
| # per tape and reel                | 3000 pieces |      |      |           |       |       |
| Controlling dimension: millimeters |             |      |      |           |       |       |

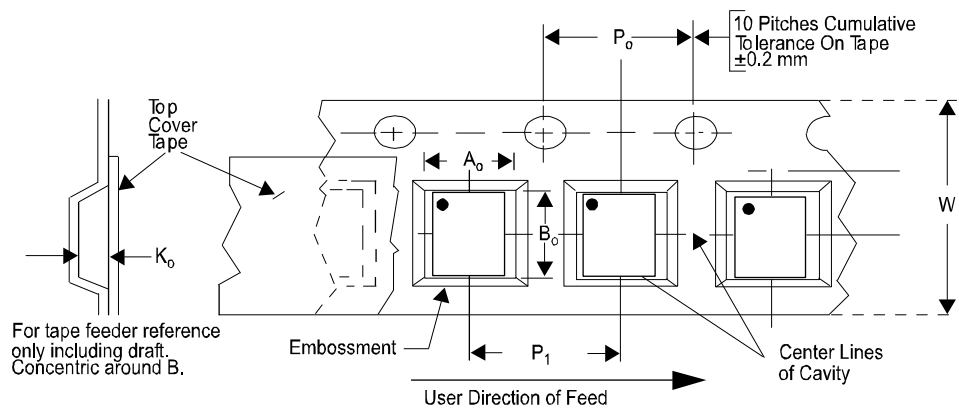



Dimensions for 16-Lead, 0.5mm pitch TDFN package

This package is compliant with JEDEC standard MO-229C with the exception of the "D", "D2", "E", "E2", "K" and "L" dimensions as called out in the table above.

**Tape and Reel Specifications**

| PART NUMBER | PACKAGE SIZE (mm)  | POCKET SIZE (mm)<br>$B_o \times A_o \times K_o$ | TAPE WIDTH<br>W | REEL DIAMETER | QTY PER REEL | $P_o$ | $P_1$ |
|-------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1409-08DE | 4.00 X 1.60 X 0.75 | 4.30 X 1.90 X 1.20                              | 12mm            | 178mm (7")    | 3000         | 4mm   | 4mm   |



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