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# 4-, 6- and 8-Channel EMI Filter Arrays with ESD Protection

## CM1636

### Features

- Four, six and 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 30dB of attenuation from 800MHz to 3GHz
- UDFN package with 0.40mm lead pitch:
  - 4-ch. = 8-lead UDFN
  - 6-ch. = 12-lead UDFN
  - 8-ch. = 16-lead UDFN
- Tiny UDFN package size:
  - 8-lead: 1.7mm x 1.35mm x 0.50mm
  - 12-lead: 2.5mm x 1.35mm x 0.50mm
  - 16-lead: 3.3mm x 1.35mm x 0.50mm
- Increased robustness against vertical impacts during manufacturing process
- Lead-free finishing

### Applications

- I/O port protection for mobile handsets, notebook computers, PDAs etc.
- EMI filtering for data ports in cell phones, PDAs or notebook computers.
- EMI filtering for LCD, camera and chip-to-chip data lines

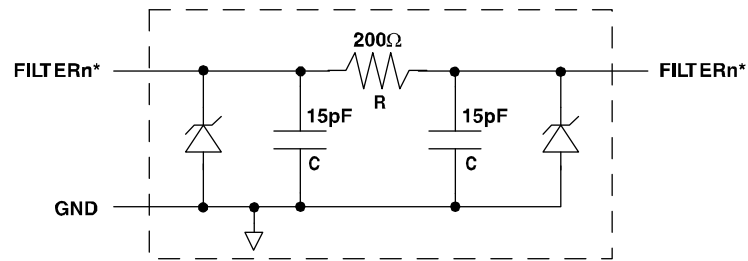
### Product Description

The CM1636 is an EMI filter array with ESD protection, which integrates either four, six or eight pi filters (C-R-C). Each CM1636 filter has component values of 15pF-200W-15pF. These parts include ESD protection diodes on every pin, providing a very high level of protection for sensitive electronic components that may be subjected to electrostatic discharge (ESD). The ESD diodes connected to the filter ports safely dissipate ESD strikes of  $\pm 15\text{kV}$  contact discharge, twice the specification requirement of the IEC 61000-4-2, Level 4 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  $\pm 30\text{kV}$ .

This device is particularly well-suited for portable electronics (e.g. mobile handsets, PDAs, notebook computers) because of its small package and easy-to-use pin assignments. In particular, the CM1636 is ideal for EMI filtering and protecting data lines from ESD in wireless handsets.

The CM1636 is available in space-saving, ultra-low-profile, 8-lead, 12-lead and 16-lead 0.4mm pitch UDFN packages. It is fabricated with California Micro Devices' *Centurion*<sup>TM</sup> process and available with lead-free finishing.

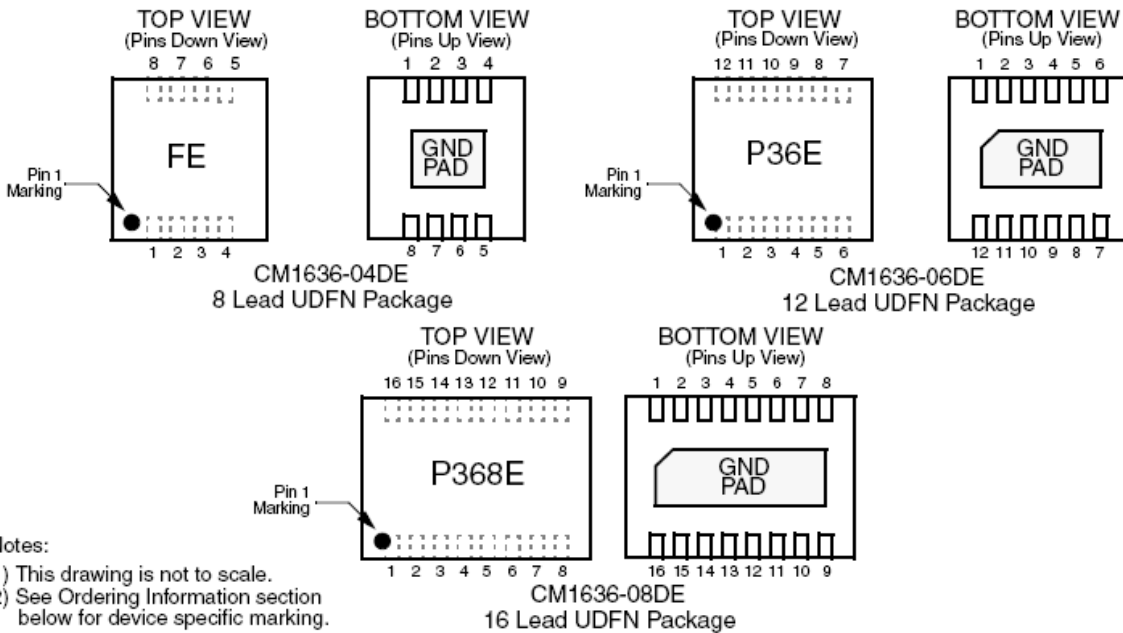
**Electrical Schematic**



**1 of 4/6/8 EMI Filtering + ESD Channels**

\* See Package/Pinout Diagram for expanded pin information.

**PACKAGE / PINOUT DIAGRAMS**



# CM1636

## PIN DESCRIPTIONS

| Pins      |           |           | NAME    | DESCRIPTION      | Pins      |           |           | NAME    | DESCRIPTION      |
|-----------|-----------|-----------|---------|------------------|-----------|-----------|-----------|---------|------------------|
| 1636-04Dx | 1636-06Dx | 1636-08Dx |         |                  | 1636-04Dx | 1636-06Dx | 1636-08Dx |         |                  |
| 1         | 1         | 1         | FILTER1 | Filter Channel 1 | 8         | 12        | 16        | FILTER1 | Filter Channel 1 |
| 2         | 2         | 2         | FILTER2 | Filter Channel 2 | 7         | 11        | 15        | FILTER2 | Filter Channel 2 |
| 3         | 3         | 3         | FILTER3 | Filter Channel 3 | 6         | 10        | 14        | FILTER3 | Filter Channel 3 |
| 4         | 4         | 4         | FILTER4 | Filter Channel 4 | 5         | 9         | 13        | FILTER4 | Filter Channel 4 |
|           | 5         | 5         | FILTER5 | Filter Channel 5 |           | 8         | 12        | FILTER5 | Filter Channel 5 |
|           | 6         | 6         | FILTER6 | Filter Channel 6 |           | 7         | 11        | FILTER6 | Filter Channel 6 |
|           |           | 7         | FILTER7 | Filter Channel 7 |           |           | 10        | FILTER7 | Filter Channel 7 |
|           |           | 8         | FILTER8 | Filter Channel 8 |           |           | 9         | FILTER8 | Filter Channel 8 |
| GND Pad   |           |           | GND     | Device Ground    |           |           |           |         |                  |

## Ordering Information

### PART NUMBERING INFORMATION

| Leads/Pins | Package | Lead-free Finish                  |              |
|------------|---------|-----------------------------------|--------------|
|            |         | Ordering Part Number <sup>1</sup> | Part Marking |
| 8          | UDFN-08 | CM1636-04DE                       | FE           |
| 12         | UDFN-12 | CM1636-06DE                       | P36E         |
| 16         | UDFN-16 | CM1636-08DE                       | P368E        |

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    |
| Package DC Power Rating   | 300         | mW    |

### STANDARD OPERATING CONDITIONS

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

**ELECTRICAL OPERATING CHARACTERISTICS** (SEE NOTE 1)

| SYMBOL              | PARAMETER  | CONDITIONS  | MIN                  | TYP         | MAX | UNITS    |
|---------------------|--|---|----------------------|-------------|-----|----------|
| R                   | Resistance   |   | 160                  | 200         | 240 | $\Omega$ |
| $C_{TOTAL}$         | Total Channel Capacitance  | At 2.5VDC Reverse Bias, 1MHz, 30mVAC  | 24                   | 30          | 36  | pF       |
| C                   | Capacitance  | At 2.5V DC, 1MHz, 30mV AC   |                      | 15          |     | pF       |
| $V_{DIODE}$         | Diode Standoff Voltage   | $I_{DIODE} = 10\mu A$   |                      | 6.0         |     | V        |
| $I_{LEAK}$          | Diode Leakage Current (reverse bias)   | $V_{DIODE} = 3.3V$  |                      | 0.1         | 1   | $\mu A$  |
| $V_{SIG}$           | Signal Voltage<br>Positive Clamp<br>Negative Clamp   | $I_{LOAD} = 10mA$<br>$I_{LOAD} = -10mA$   | 5.6<br>-0.4          | 6.8<br>-0.8 |     | V<br>V   |
| $V_{ESD}$           | 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 | Notes 2   | $\pm 30$<br>$\pm 15$ |             |     | kV<br>kV |
| $f_c$               | Cut-off Frequency<br>$Z_{SOURCE} = 50\Omega$ , $Z_{LOAD} = 50\Omega$   | $R = 200\Omega$ , $C = 15pF$ ;<br>Note 3  |                      | 100         |     | MHz      |
| $A_{1GHz}$          | Absolute Attenuation @ 1GHz from 0dB Level   | $Z_{SOURCE} = 50\Omega$ , $Z_{LOAD} = 50\Omega$ ,<br>DC Bias = 0V; Notes 1 and 3  |                      | 35          |     | dB       |
| $A_{800MHz - 6GHz}$ | Absolute Attenuation @ 800MHz to 6GHz from 0dB Level   | $Z_{SOURCE} = 50\Omega$ , $Z_{LOAD} = 50\Omega$ ,<br>DC Bias = 0V; Notes 1 and 35 |                      | 30          |     | dB       |

Note 1:  $T_A = 25^\circ C$  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)

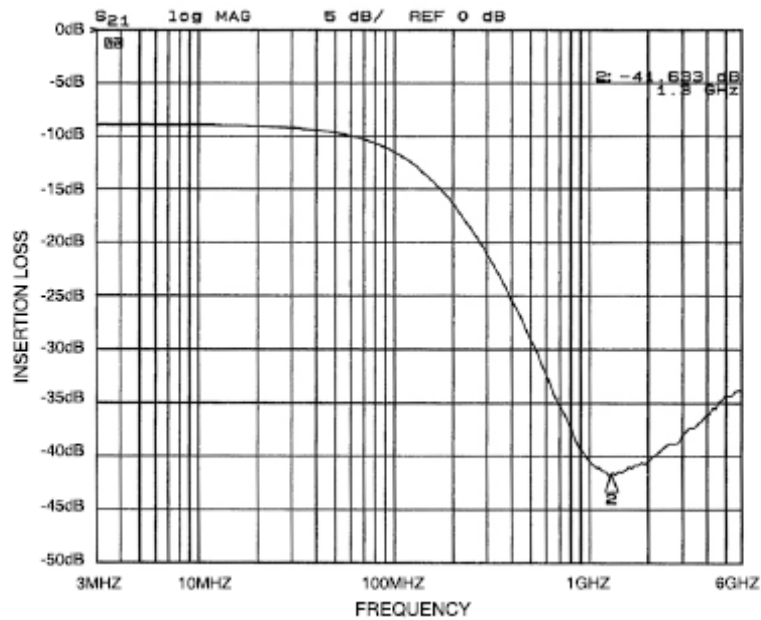


Figure 1. Insertion Loss vs. Frequency (FILTER1 Input to GND, CM1636-04DE)

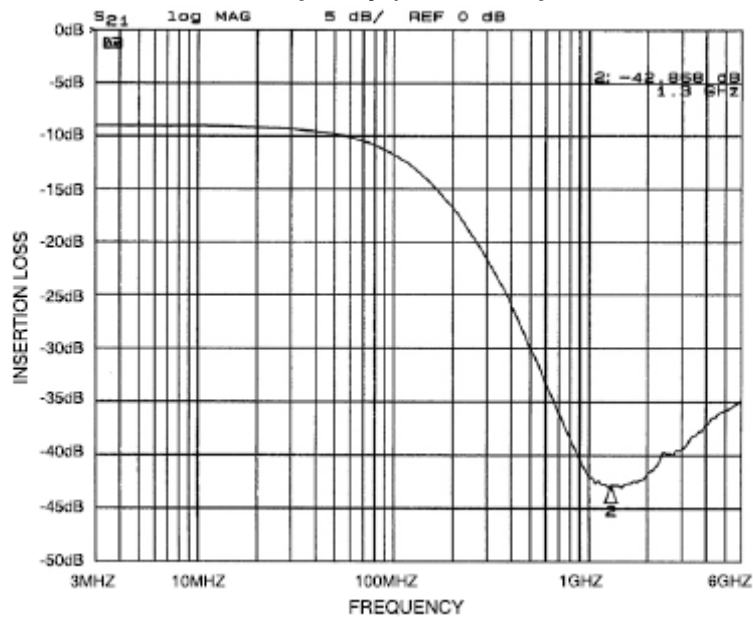


Figure 2. Insertion Loss vs. Frequency (FILTER2 Input to GND, CM1636-04DE)

Performance Information (cont'd)

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

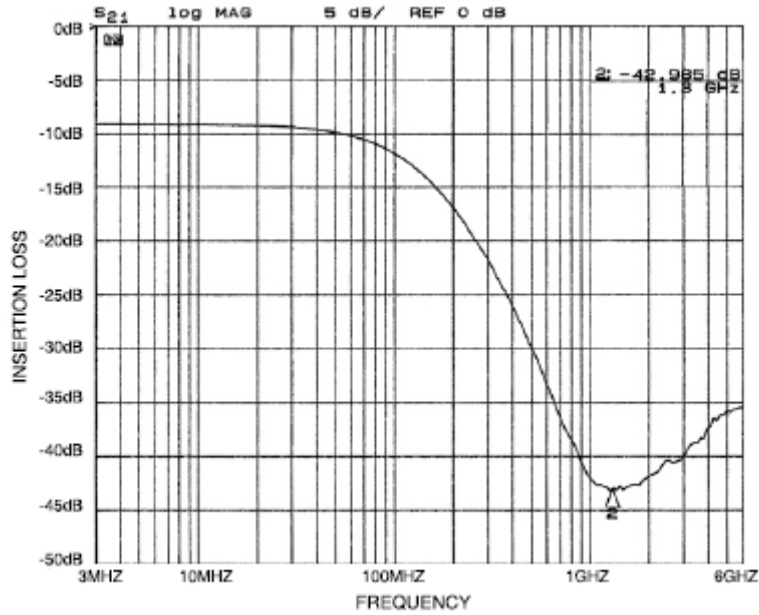


Figure 3. Insertion Loss vs. Frequency (FILTER3 Input to GND, CM1636-04DE)

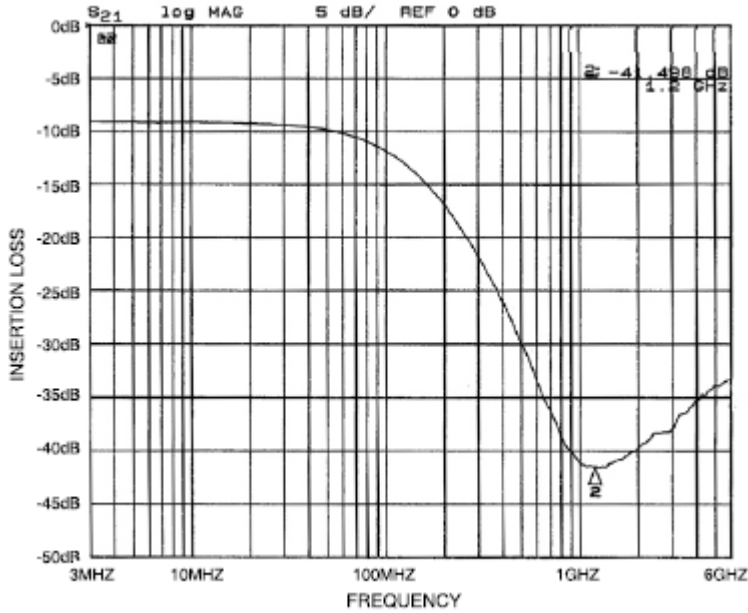


Figure 4. Insertion Loss vs. Frequency (FILTER4 Input to GND, CM1636-04DE)



## Performance Information (cont'd)

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

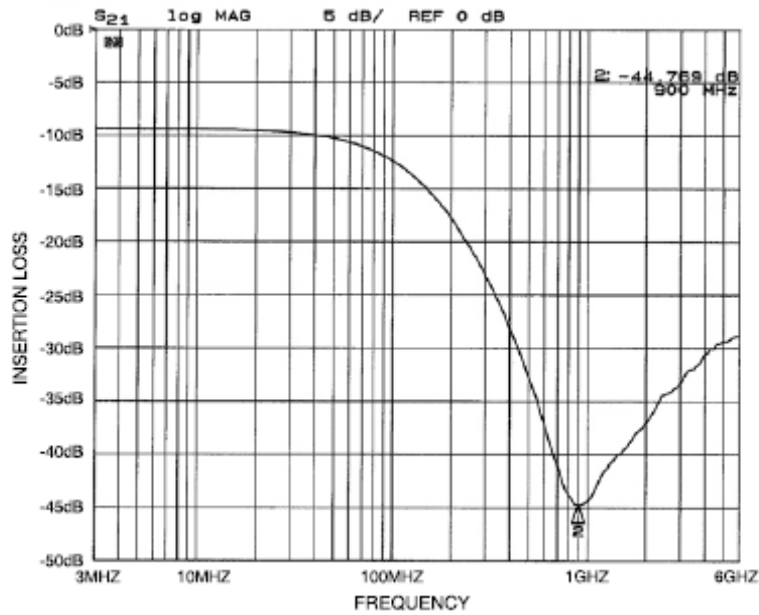


Figure 5. Insertion Loss vs. Frequency (FILTER1 Input to GND, CM1636-06DE)

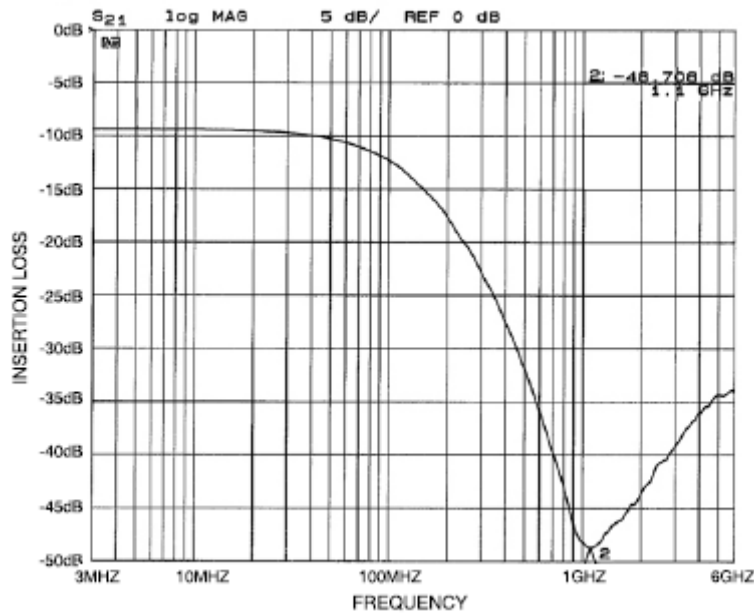


Figure 6. Insertion Loss vs. Frequency (FILTER2 Input to GND, CM1636-06DE)

Performance Information (cont'd)

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

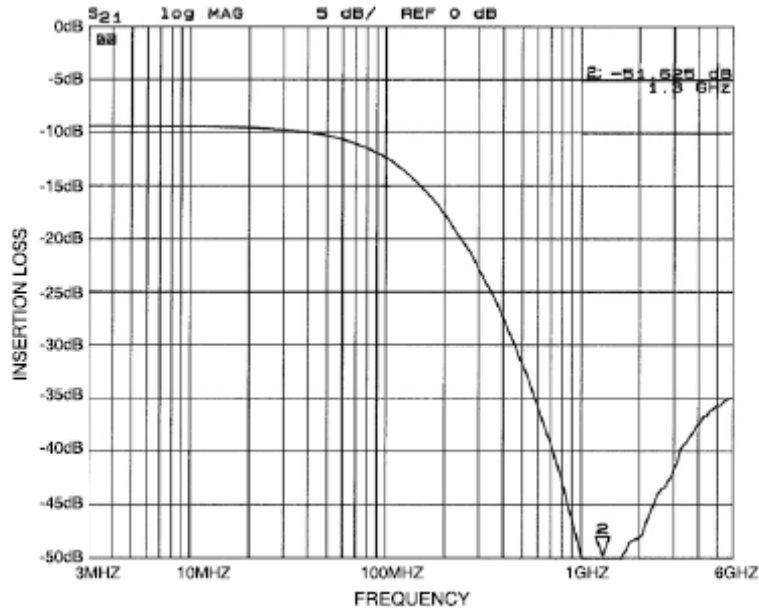


Figure 7. Insertion Loss vs. Frequency (FILTER3 Input to GND, CM1636-06DE)

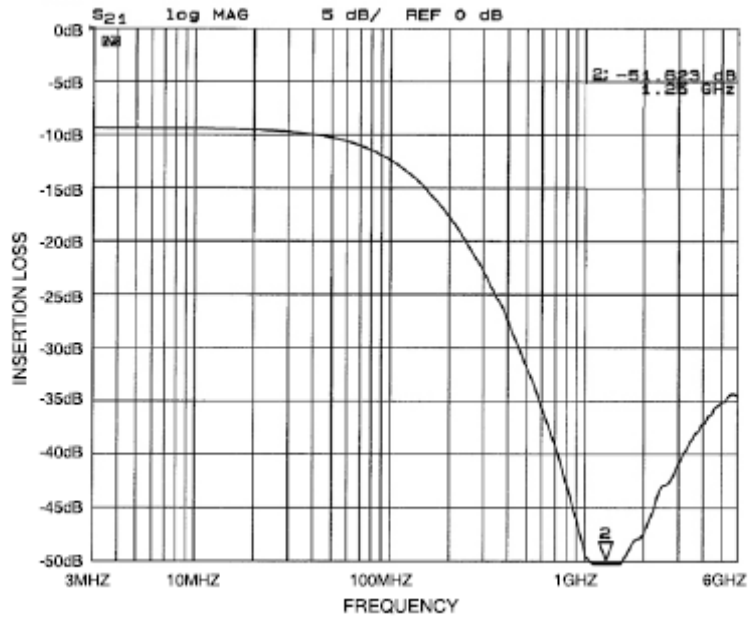


Figure 8. Insertion Loss vs. Frequency (FILTER4 Input to GND, CM1636-06DE)

## Performance Information (cont'd)

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

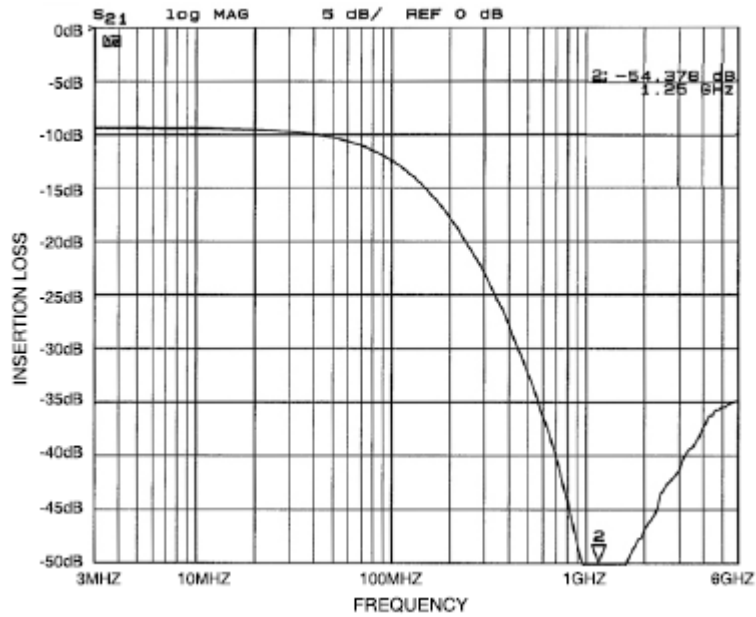


Figure 9. Insertion Loss vs. Frequency (FILTER5 Input to GND, CM1636-06DE)

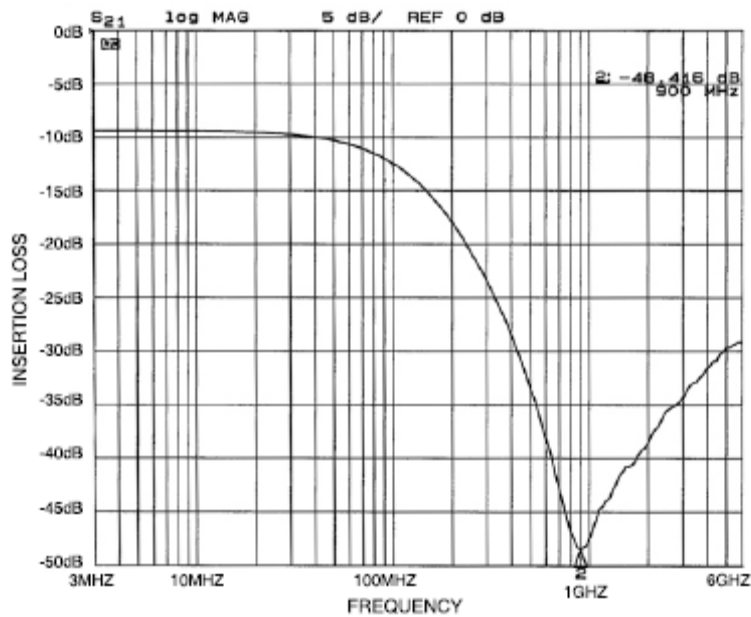


Figure 10. Insertion Loss vs. Frequency (FILTER6 Input to GND, CM1636-06DE)

Performance Information (cont'd)

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

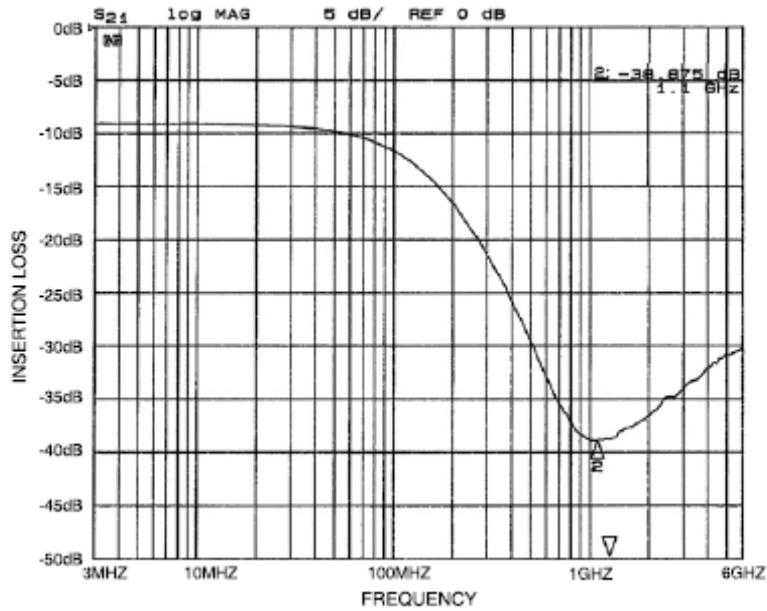


Figure 11. Insertion Loss vs. Frequency (FILTER1 Input to GND, CM1636-08DE)

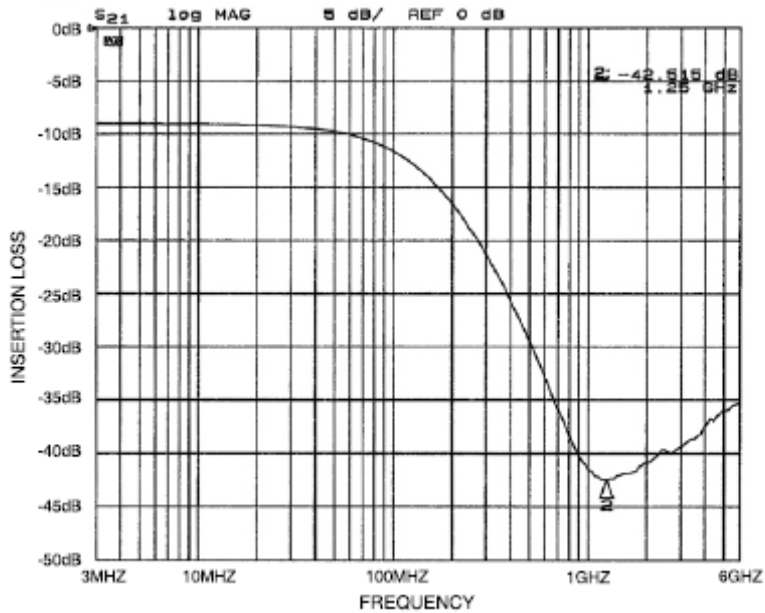


Figure 12. Insertion Loss vs. Frequency (FILTER2 Input to GND, CM1636-08DE)

## Performance Information (cont'd)

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

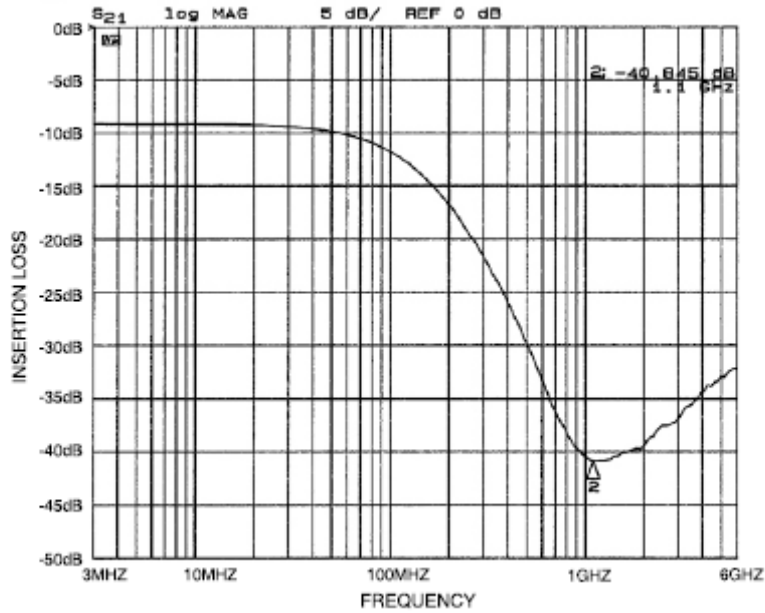


Figure 13. Insertion Loss vs. Frequency (FILTER3 Input to GND, CM1636-08DE)

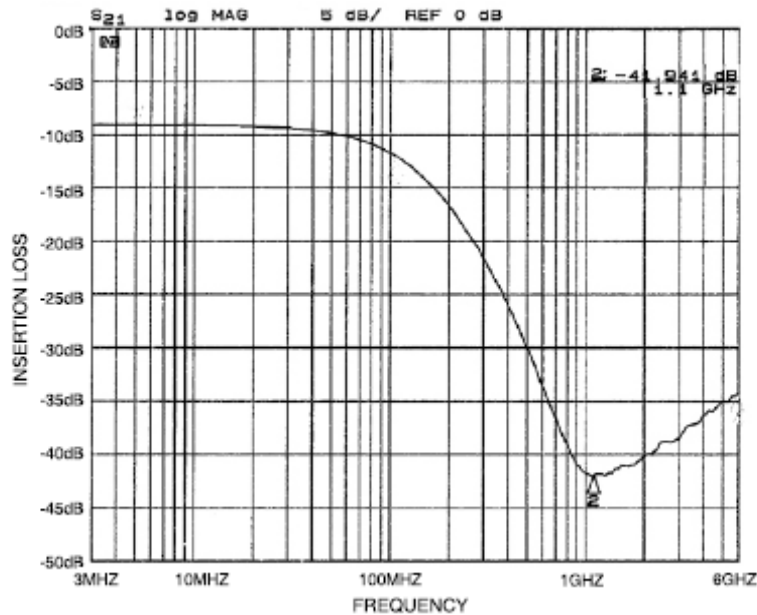


Figure 14. Insertion Loss vs. Frequency (FILTER4 Input to GND, CM1636-08DE)

Performance Information (cont'd)

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

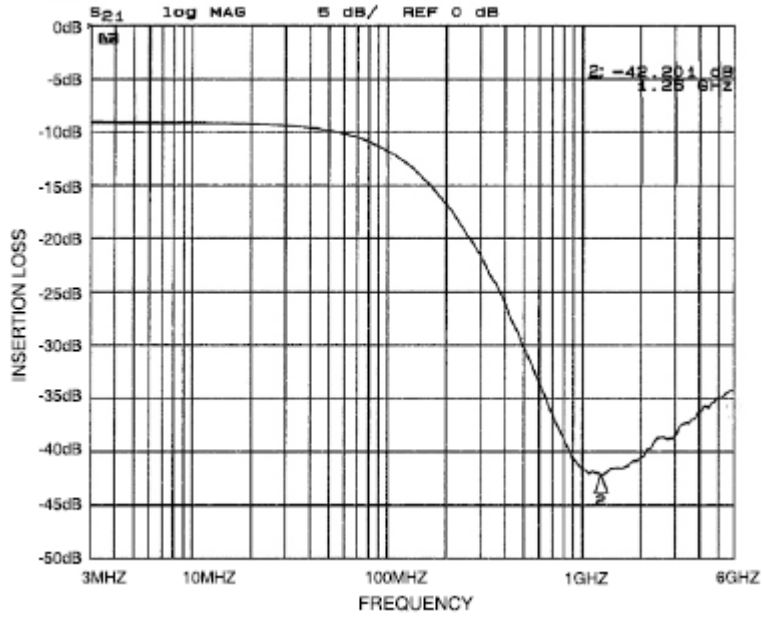


Figure 15. Insertion Loss vs. Frequency (FILTER5 Input to GND, CM1636-08DE)

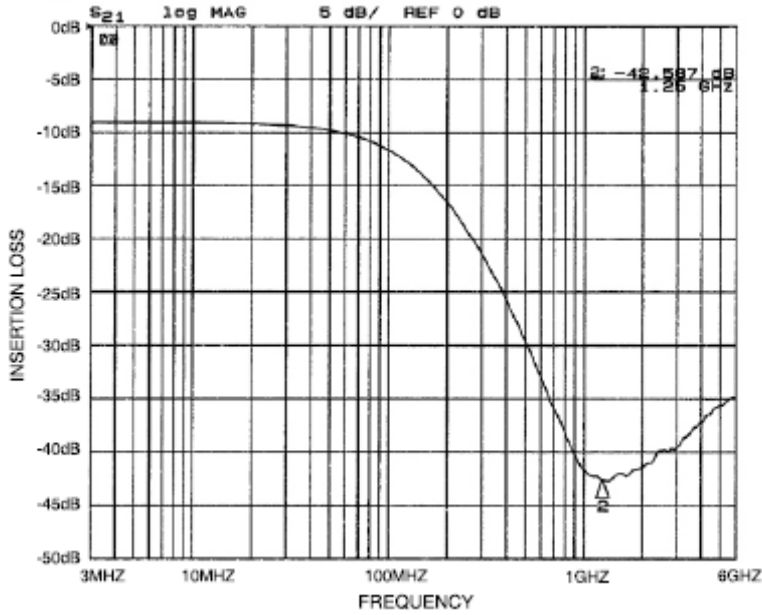


Figure 16. Insertion Loss vs. Frequency (FILTER6 Input to GND, CM1636-08DE)

## Performance Information (cont'd)

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

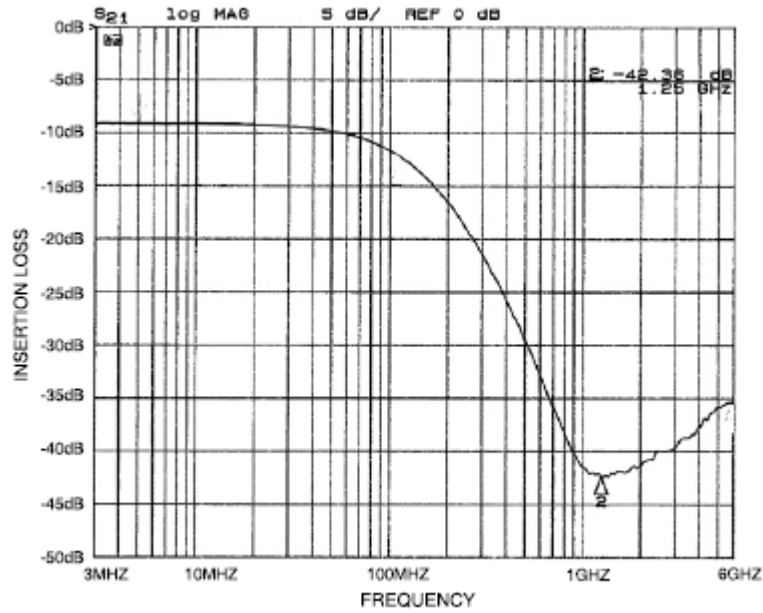


Figure 17. Insertion Loss vs. Frequency (FILTER7 Input to GND, CM1636-08DE)

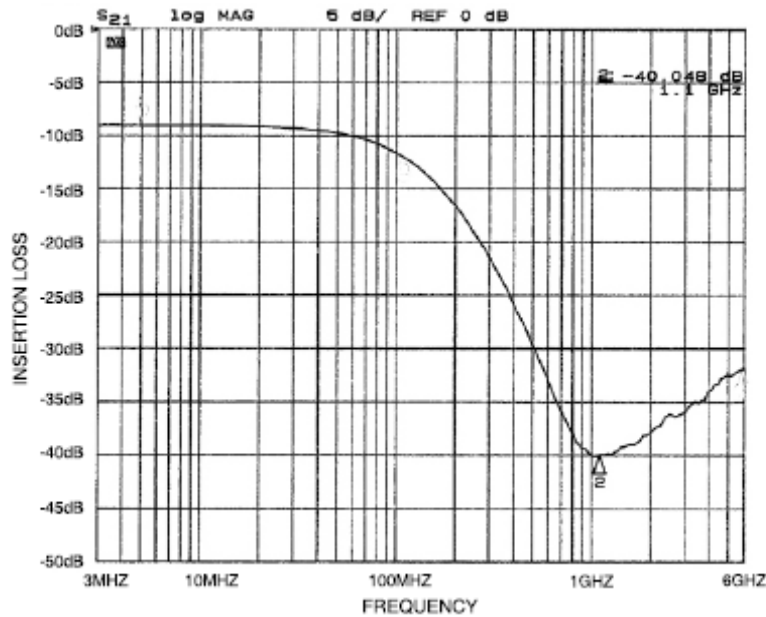


Figure 18. Insertion Loss vs. Frequency (FILTER8 Input to GND, CM1636-08DE)



Performance Information (cont'd)

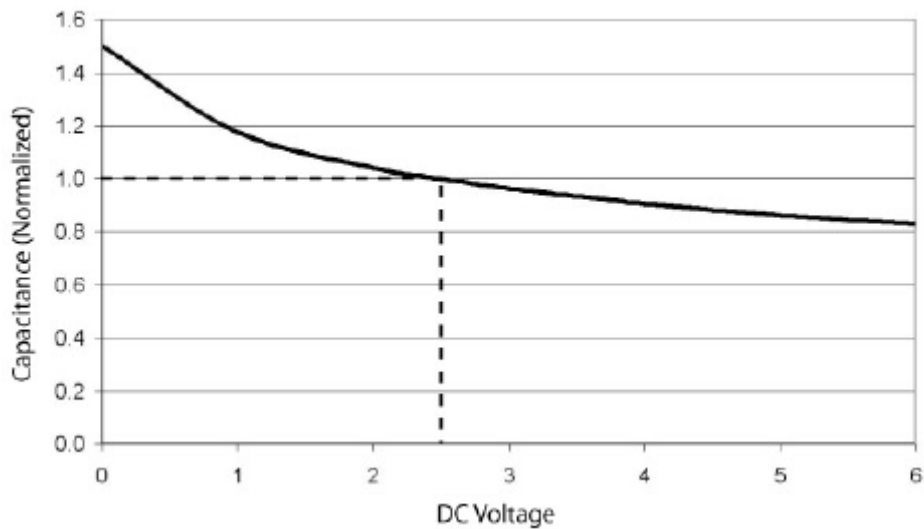


Figure 19. Filter Capacitance vs. Input Voltage over Temperature (normalized to capacitance at 2.5VDC and 25°C)

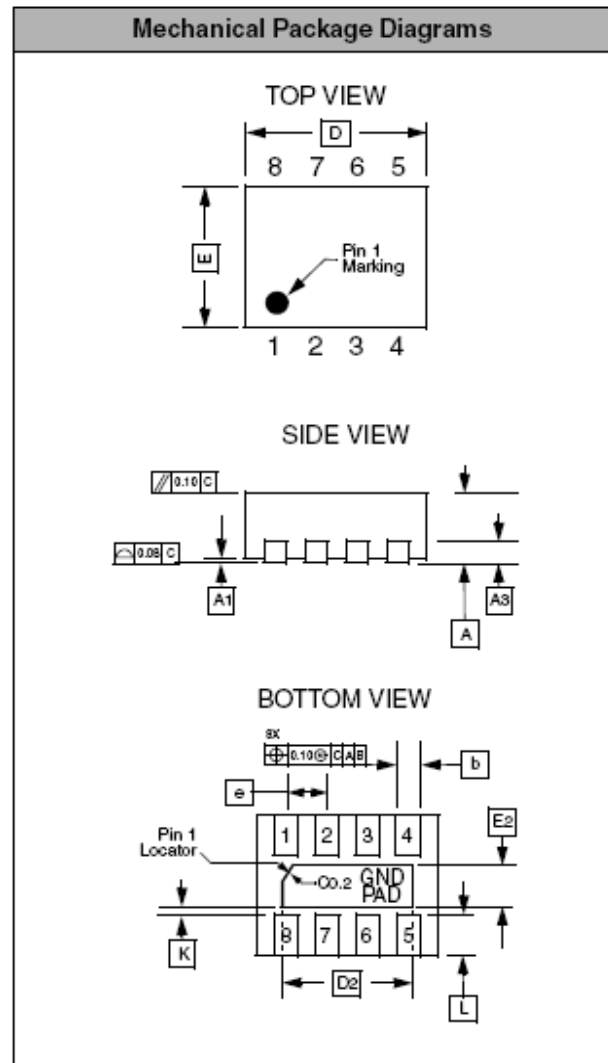
## Mechanical Details

### UDFN-08 Mechanical Specifications

Dimensions for the CM1636 supplied in a 8-lead, 0.4mm pitch UDFN package are presented below.

| PACKAGE DIMENSIONS                 |             |      |      |           |       |       |
|------------------------------------|-------------|------|------|-----------|-------|-------|
| Package                            | uDFN        |      |      |           |       |       |
| JEDEC No.                          | MO-229C*    |      |      |           |       |       |
| Leads                              | 8           |      |      |           |       |       |
| Dim.                               | Millimeters |      |      | Inches    |       |       |
|                                    | Min         | Nom  | Max  | Min       | Nom   | Max   |
| A                                  | 0.45        | 0.50 | 0.55 | 0.018     | 0.020 | 0.022 |
| A1                                 | 0.00        | 0.02 | 0.05 | 0.000     | 0.001 | 0.002 |
| A3                                 | 0.127 REF   |      |      | 0.005 REF |       |       |
| b                                  | 0.15        | 0.20 | 0.25 | 0.006     | 0.008 | 0.010 |
| D                                  | 1.60        | 1.70 | 1.80 | 0.063     | 0.067 | 0.071 |
| D2                                 | 1.10        | 1.20 | 1.30 | 0.043     | 0.047 | 0.051 |
| E                                  | 1.25        | 1.35 | 1.45 | 0.049     | 0.053 | 0.057 |
| E2                                 | 0.30        | 0.40 | 0.50 | 0.012     | 0.016 | 0.020 |
| e                                  | 0.40 BSC    |      |      | 0.016 BSC |       |       |
| K                                  | 0.22 REF    |      |      | 0.009 REF |       |       |
| L                                  | 0.15        | 0.25 | 0.35 | 0.006     | 0.010 | 0.014 |
| # per tape and reel                | 3000 pieces |      |      |           |       |       |
| Controlling dimension: millimeters |             |      |      |           |       |       |

\* 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.

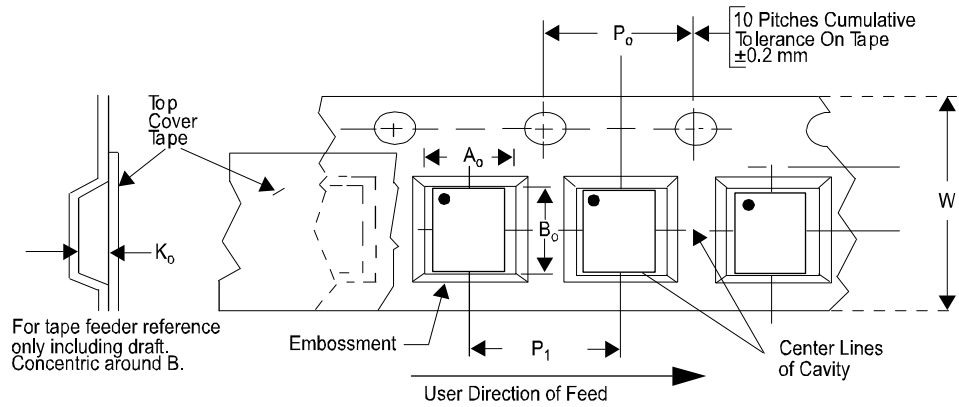


Dimensions for 8-Lead, 0.4mm pitch uDFN package

# CM1636

## 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 | $P_o$ | $P_1$ |
|-------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1636-04DE | 1.70 X 1.35 X 0.50 | 1.95 X 1.60 X 0.60                              | 8mm             | 178mm (7")    | 3000         | 4mm   | 4mm   |



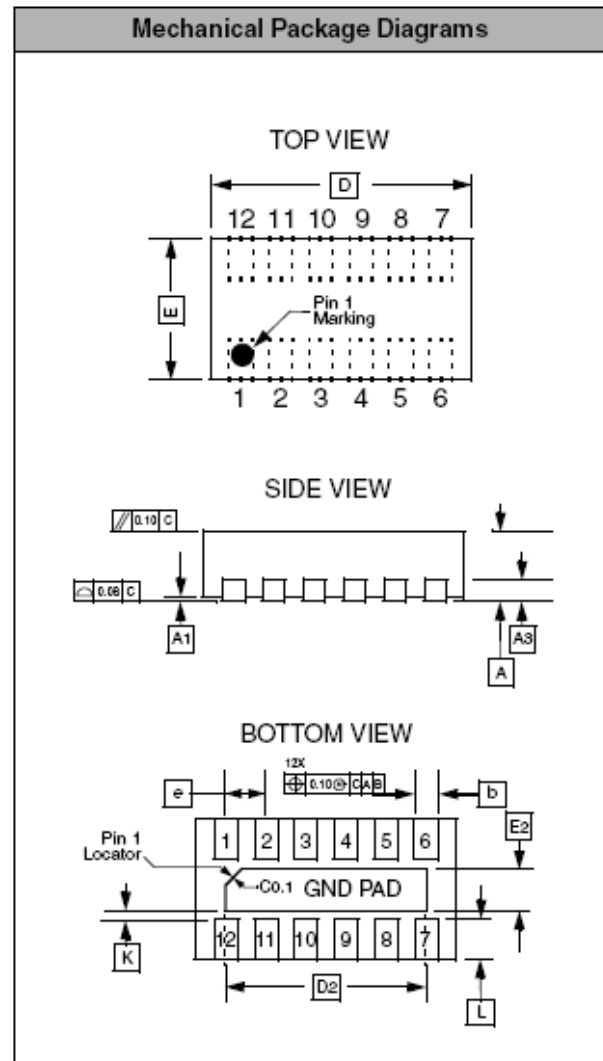
## Mechanical Details (cont'd)

### UDFN-12 Mechanical Specifications

Dimensions for the CM1636 supplied in a 12-lead, 0.4mm pitch UDFN package are presented below.

| PACKAGE DIMENSIONS                 |             |      |      |           |       |       |
|------------------------------------|-------------|------|------|-----------|-------|-------|
| Package                            | uDFN        |      |      |           |       |       |
| JEDEC No.                          | MO-229C*    |      |      |           |       |       |
| Leads                              | 12          |      |      |           |       |       |
| Dim.                               | Millimeters |      |      | Inches    |       |       |
|                                    | Min         | Nom  | Max  | Min       | Nom   | Max   |
| A                                  | 0.45        | 0.50 | 0.55 | 0.018     | 0.020 | 0.022 |
| A1                                 | 0.00        | 0.02 | 0.05 | 0.000     | 0.001 | 0.002 |
| A3                                 | 0.127 REF   |      |      | 0.005 REF |       |       |
| b                                  | 0.15        | 0.20 | 0.25 | 0.006     | 0.008 | 0.010 |
| D                                  | 2.40        | 2.50 | 2.60 | 0.094     | 0.098 | 0.102 |
| D2                                 | 1.90        | 2.00 | 2.10 | 0.075     | 0.079 | 0.083 |
| E                                  | 1.25        | 1.35 | 1.45 | 0.049     | 0.053 | 0.057 |
| E2                                 | 0.30        | 0.40 | 0.50 | 0.012     | 0.016 | 0.020 |
| e                                  | 0.40 BSC    |      |      | 0.016 BSC |       |       |
| K                                  | 0.22 REF    |      |      | 0.009 REF |       |       |
| L                                  | 0.15        | 0.25 | 0.35 | 0.006     | 0.010 | 0.014 |
| # per tape and reel                | 3000 pieces |      |      |           |       |       |
| Controlling dimension: millimeters |             |      |      |           |       |       |

\* 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.

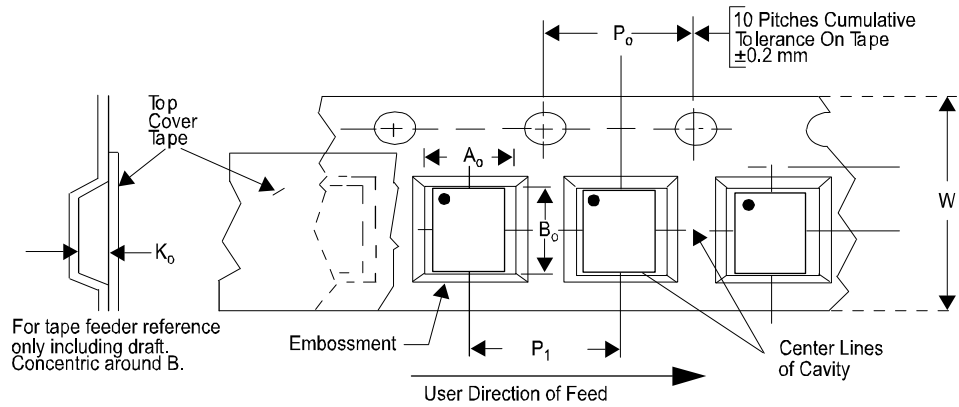


Dimensions for 12-Lead, 0.4mm pitch uDFN package

# CM1636

## 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 | $P_o$ | $P_1$ |
|-------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1636-06DE | 2.50 X 1.35 X 0.50 | 2.75 X 1.60 X 0.60                              | 8mm             | 178mm (7")    | 3000         | 4mm   | 4mm   |



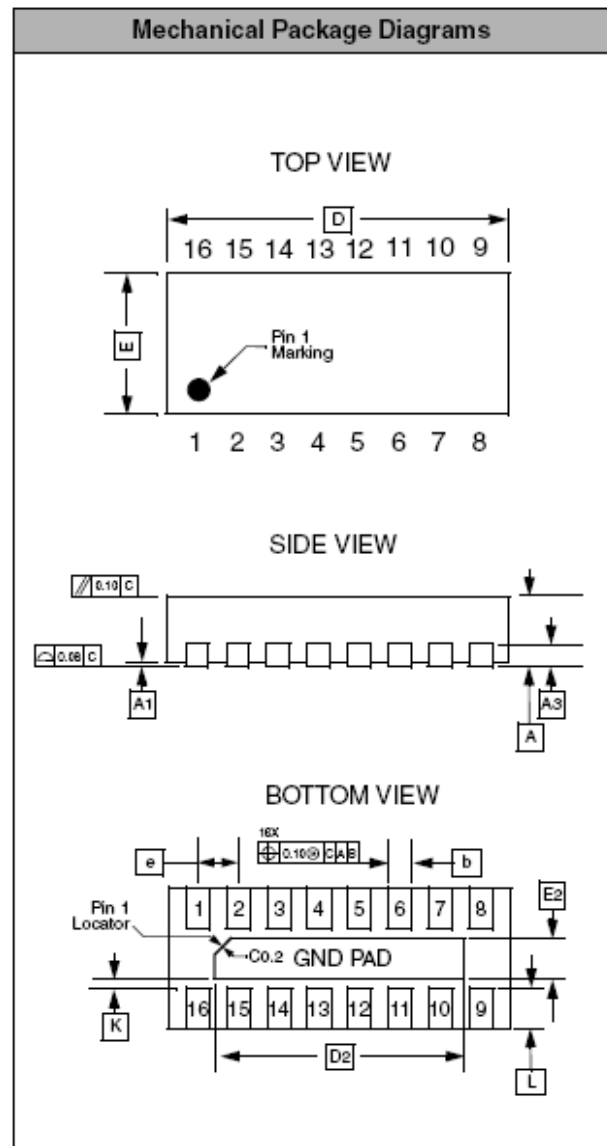
## Mechanical Details (cont'd)

### UDFN-16 Mechanical Specifications

Dimensions for the CM1636 supplied in a 16-lead, 0.4mm pitch UDFN package are presented below. The 16-lead, 0.4mm pitch uDFN package dimensions are presented below.

| PACKAGE DIMENSIONS                 |             |      |      |           |       |       |
|------------------------------------|-------------|------|------|-----------|-------|-------|
| Package                            | uDFN        |      |      |           |       |       |
| JEDEC No.                          | MO-229C*    |      |      |           |       |       |
| Leads                              | 16          |      |      |           |       |       |
| Dim.                               | Millimeters |      |      | Inches    |       |       |
|                                    | Min         | Nom  | Max  | Min       | Nom   | Max   |
| A                                  | 0.45        | 0.50 | 0.55 | 0.018     | 0.020 | 0.022 |
| A1                                 | 0.00        | 0.02 | 0.05 | 0.000     | 0.001 | 0.002 |
| A3                                 | 0.127 REF   |      |      | 0.005 REF |       |       |
| b                                  | 0.15        | 0.20 | 0.25 | 0.006     | 0.008 | 0.010 |
| D                                  | 3.20        | 3.30 | 3.40 | 0.126     | 0.130 | 0.134 |
| D2                                 | 2.70        | 2.80 | 2.90 | 0.106     | 0.110 | 0.114 |
| E                                  | 1.25        | 1.35 | 1.45 | 0.049     | 0.053 | 0.057 |
| E2                                 | 0.30        | 0.40 | 0.50 | 0.012     | 0.016 | 0.020 |
| e                                  | 0.40 BSC    |      |      | 0.016 BSC |       |       |
| K                                  | 0.22 REF    |      |      | 0.009 REF |       |       |
| L                                  | 0.15        | 0.25 | 0.35 | 0.006     | 0.010 | 0.014 |
| # per tape and reel                | 3000 pieces |      |      |           |       |       |
| Controlling dimension: millimeters |             |      |      |           |       |       |

\*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.

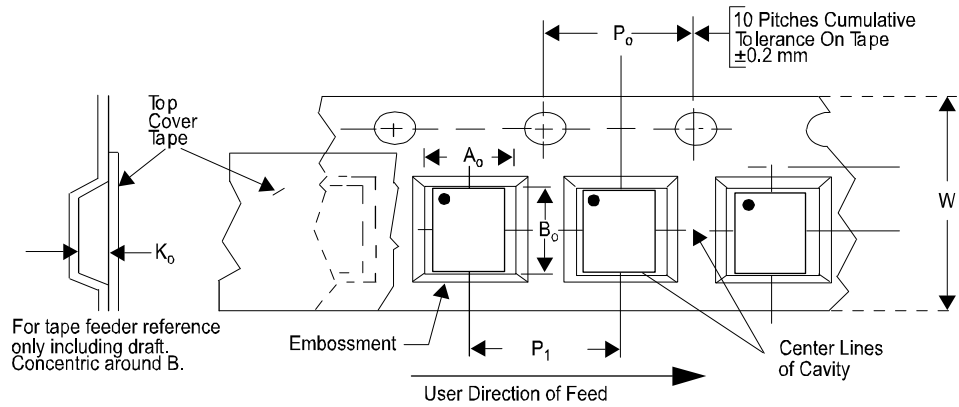


Dimensions for 16-Lead, 0.4mm pitch uDFN package


# CM1636

## 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 | $P_o$ | $P_1$ |
|-------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1636-08DE | 3.30 X 1.35 X 0.50 | 3.50 X 1.55 X 0.70                              | 12mm            | 178mm (7")    | 3000         | 4mm   | 4mm   |





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