

## HDMI Transmitter Port Protection and Interface Device

### Features

- 0.05pF matching capacitance between the TMDS intra-pair
- Overcurrent output protection
- Level shifting circuitry, including  $\pm 8\text{kV}$  ESD protection on all TMDS lines
- Matched 0.5mm trace spacing (TSSOP)
- Simplified layout for HDMI connectors
- Backdrive protection

### Applications

- PC
- Consumer Electronics
- Set Top Box
- Displays and Digital Television

### Product Description

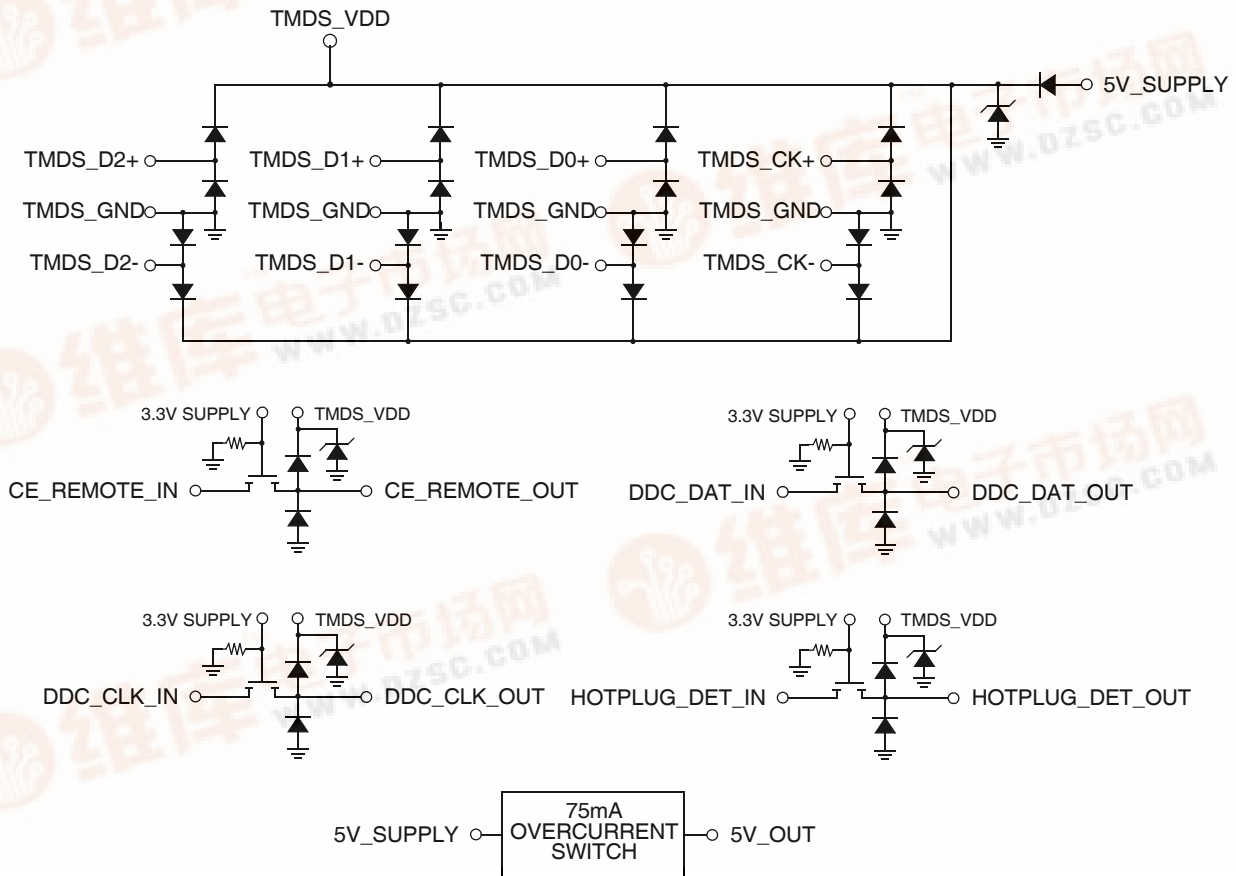
The CM2020 HDMI Transmitter Port Protection and Interface Device is specifically designed for next generation HDMI Host interface protection.

An integrated package provides all ESD, level shift, overcurrent output protection and backdrive protection for an HDMI port in a single 38-Pin TSSOP package.

The CM2020 part is specifically designed to complement the CM2021 protection part in HDMI receivers (Displays, CE devices, etc.)

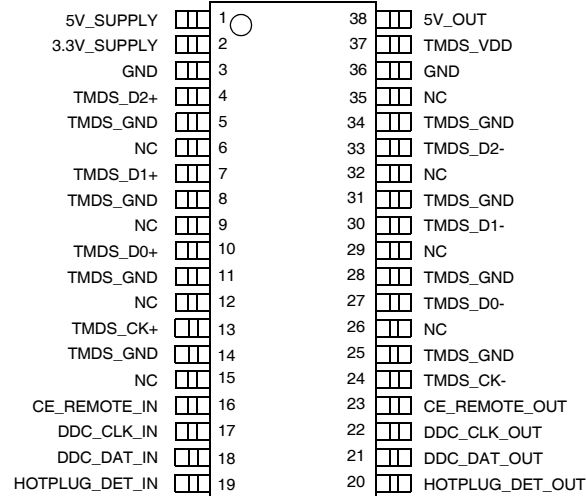
The CM2020 also incorporates a silicon overcurrent protection device for +5V supply voltage output to the connector.

### Electrical Schematic



**PACKAGE / PINOUT DIAGRAM**

## TOP VIEW



38-PIN TSSOP PACKAGE

Note: This drawing is not to scale.

**PIN DESCRIPTIONS**

| PINS                                | NAME            | DESCRIPTION   |
|-------------------------------------|-----------------|---|
| 37                                  | TMDS_VDD        | TMDS ESD diodes biased from 5V_SUPPLY through internal diode. |
| 4                                   | TMDS_D2+        | TMDS 0.9pF ESD protection.                                    |
| 33                                  | TMDS_D2-        | TMDS 0.9pF ESD protection.                                    |
| 7                                   | TMDS_D1+        | TMDS 0.9pF ESD protection.                                    |
| 30                                  | TMDS_D1-        | TMDS 0.9pF ESD protection.                                    |
| 10                                  | TMDS_D0+        | TMDS 0.9pF ESD protection.                                    |
| 27                                  | TMDS_D0-        | TMDS 0.9pF ESD protection.                                    |
| 13                                  | TMDS_CK+        | TMDS 0.9pF ESD protection.                                    |
| 24                                  | TMDS_CK-        | TMDS 1pF ESD protection.                                      |
| 16                                  | CE_REMOTE_IN    | 3.3V_SUPPLY referenced logic level in.                        |
| 23                                  | CE_REMOTE_OUT   | 5V_SUPPLY referenced logic level out plus 4pF ESD.            |
| 17                                  | DDC_CLK_IN      | 3.3V_SUPPLY referenced logic level in.                        |
| 22                                  | DDC_CLK_OUT     | 5V_SUPPLY referenced logic level out plus 4pF ESD.            |
| 18                                  | DDC_DAT_IN      | 3.3V_SUPPLY referenced logic level in.                        |
| 21                                  | DDC_DAT_OUT     | 5V_SUPPLY referenced logic level out plus 4pF ESD.            |
| 19                                  | HOTPLUG_DET_IN  | 3.3V_SUPPLY referenced logic level in.                        |
| 20                                  | HOTPLUG_DET_OUT | 5V_SUPPLY referenced logic level out plus 4pF ESD.            |
| 2                                   | 3.3V_SUPPLY     | Bias for CE / DDC / HOTPLUG level shifters.                   |
| 1                                   | 5V_SUPPLY       | Current source for 5V_OUT.                                    |
| 38                                  | 5V_OUT          | 75mA minimum overcurrent protected 5V output.                 |
| 3, 5, 8, 11, 14, 25, 28, 31, 34, 36 | GND / TMDS_GND  | GND reference.  |
| 6, 9, 12, 15, 26, 29, 32, 35        | NC              | No Connect.   |

## Ordering Information

| PART NUMBERING INFORMATION |          |                                   |              |                                   |              |
|----------------------------|----------|-----------------------------------|--------------|-----------------------------------|--------------|
| Pins                       | Package  | Standard Finish                   |              | Lead-free Finish                  |              |
|                            |          | Ordering Part Number <sup>1</sup> | Part Marking | Ordering Part Number <sup>1</sup> | Part Marking |
| 38                         | TSSOP-38 | CM2020-00TS                       | CM2020-00TS  | CM2020-00TR                       | CM2020-00TR  |

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

## Specifications

| ABSOLUTE MAXIMUM RATINGS                    |                            |       |
|---|----------------------------|-------|
| PARAMETER                                   | RATING                     | UNITS |
| $V_{CC5}, V_{CC3}$                          | 6.0                        | V     |
| ESD Clamp Diode Forward DC Current (Note 1) | 8                          | mA    |
| DC Voltage at any Channel Input             | [GND - 0.5] to [VCC + 0.5] | V     |
| Storage Temperature Range                   | -65 to +150                | °C    |
| Operating Temperature Range                 | -40 to +85                 | °C    |

Note 1: Only one diode conducting at a time.

| STANDARD (RECOMMENDED) OPERATING CONDITIONS |                          |     |     |     |       |
|---|--------------------------|-----|-----|-----|-------|
| SYMBOL                                      | PARAMETER                | MIN | TYP | MAX | UNITS |
| 5V_SUPPLY                                   | Operating Supply Voltage |     | 5   | 5.5 | V     |
| 3.3V_SUPPLY                                 | Bias Supply Voltage      | 1   | 3.3 | 5.5 | V     |

**Specifications (cont'd)**

| ELECTRICAL OPERATING CHARACTERISTICS (SEE NOTE 1) |   |  |            |              |              |                      |
|---|---|--|------------|--------------|--------------|----------------------|
| SYMBOL  | PARAMETER   | CONDITIONS   | MIN        | TYP          | MAX          | UNITS                |
| $I_{CC5}$   | Operating Supply Current  | 5V_SUPPLY = 5.0V   | 100        | 110          | 130          | $\mu$ A              |
| $I_{CC3}$   | Bias Supply Current   | 3.3V_SUPPLY = 3.3V   |            | 1            | 5            | $\mu$ A              |
| $V_{DROP}$  | 5V_OUT Overcurrent Output Drop  | 5V_SUPPLY= 5.0V,<br>$I_{OUT}=55$ mA  |            | 65           | 100          | mV                   |
| $I_{SC}$  | 5V_OUT Short Circuit Current Limit  | 5V_SUPPLY= 5.0V,<br>5V_OUT = GND   | 90         | 135          | 175          | mA                   |
| $I_{OFF}$   | OFF state leakage current, level shifting NFET                                    | 3.3V_SUPPLY = 0V   |            | 0.1          | 5            | $\mu$ A              |
| $I_{BACKDRIVE}$                                   | Current conducted from output pins to V_SUPPLY rails when powered down            | 5V_SUPPLY < $V_{CH\_OUT}$ ;<br>Signal pins: TMDS_[2:0]+/-,<br>TMDS_CK+/-, CE_REMOTE_OUT,<br>DDC_DAT_OUT, DDC_CLK_OUT,<br>HOTPLUG_DET_OUT, 5V_OUT<br>Only |            | 0.1          | 5            | $\mu$ A              |
| $V_{ON}$  | VOLTAGE drop across level shifting NFET when ON                                   | 3.3V_SUPPLY = 2.5V, $V_S$ = GND,<br>$I_{DS}$ = 3mA   | 75         | 95           | 140          | mV                   |
| $V_F$   | Diode Forward Voltage<br>Top Diode<br>Bottom Diode                                | $I_F$ = 8mA, $T_A$ = 25°C, Note 2  | 0.6<br>0.6 | 0.85<br>0.85 | 0.95<br>0.95 | V<br>V               |
| $V_{ESD}$   | ESD Withstand Voltage (IEC)   | Pins 4, 7, 10, 13, 20, 21, 22, 23, 24,<br>27, 30, 33; Notes 2 and 3  | $\pm$ 8    |              |              | kV                   |
| $V_{ESD}$   | ESD Withstand Voltage (HBM)   | Pins 1, 2, 16, 17, 18, 19, 37, 38;<br>Notes 2 and 4  | $\pm$ 2    |              |              | kV                   |
| $V_{CL}$  | Channel Clamp Voltage @ 8kV HBM ESD<br>Positive Transients<br>Negative Transients | $T_A$ = 25°C, Notes 2 and 4  |            | 9.0<br>-9.0  |              | V<br>V               |
| $R_{DYN}$   | Dynamic Resistance<br>Positive Transients<br>Negative Transients                  | $I$ = 1A, $T_A$ = 25°C, Note 5   |            | 3.0<br>1.5   |              | $\Omega$<br>$\Omega$ |
| $I_{LEAK}$  | TMDS Channel Leakage Current  | $T_A$ = 25°C, Note 2   |            | 0.01         | 1            | $\mu$ A              |
| $C_{IN, TMDS}$                                    | TMDS Channel Input Capacitance  | 5V_SUPPLY= 5.0V,<br>Measured at 1MHz,<br>$V_{BIAS}=2.5$ V, Note 2  |            | 0.9          | 1.2          | pF                   |
| $\Delta C_{IN, TMDS}$                             | $C_{IN}$ Matching Capacitance   | 5V_SUPPLY= 5.0V,<br>Measured at 1MHz,<br>$V_{BIAS}=2.5$ V, Note 2, 6   |            | 0.05         |              | pF                   |
| $C_{MUTUAL}$                                      | Mutual Capacitance between signal pin and NC pin                                  | 5V_SUPPLY= 0V,<br>Measured at 1MHz,<br>$V_{BIAS}=2.5$ V, Note 2  |            | 0.07         |              | pF                   |

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

|               |  |   |  |   |   |    |
|---------------|--|---|--|---|---|----|
| $C_{IN, DDC}$ | Level Shifting Input Capacitance, Capacitance to GND | 5V_SUPPLY= 0V,<br>Measured at 100KHz,<br>$V_{BIAS}=2.5V$ , Note 2 |  | 4 | 6 | pF |
| $C_{IN, CEC}$ | Level Shifting Input Capacitance, Capacitance to GND | 5V_SUPPLY= 0V,<br>Measured at 100KHz,<br>$V_{BIAS}=2.5V$ , Note 2 |  | 4 | 6 | pF |
| $C_{IN, HP}$  | Level Shifting Input Capacitance, Capacitance to GND | 5V_SUPPLY= 0V,<br>Measured at 100KHz,<br>$V_{BIAS}=2.5V$ , Note 2 |  | 4 | 6 | pF |

Note 1: Operating Characteristics are over Standard Operating Conditions unless otherwise specified.

Note 2: This parameter is guaranteed by design and verified by device characterization.

Note 3: Standard IEC 61000-4-2,  $C_{DISCHARGE}=150pF$ ,  $R_{DISCHARGE}=330\Omega$

Note 4: Human Body Model per MIL-STD-883, Method 3015,  $C_{DISCHARGE}=100pF$ ,  $R_{DISCHARGE}=1.5k\Omega$

Note 5: These measurements performed with no external capacitor on TMD5\_VDD.

Note 6: Intra-pair matching, each TMDS pair (i.e. D+, D-)

**Performance Information**

Typical Filter Performance (T<sub>A</sub>=25°C, DC Bias=0V, 50 Ohm Environment)

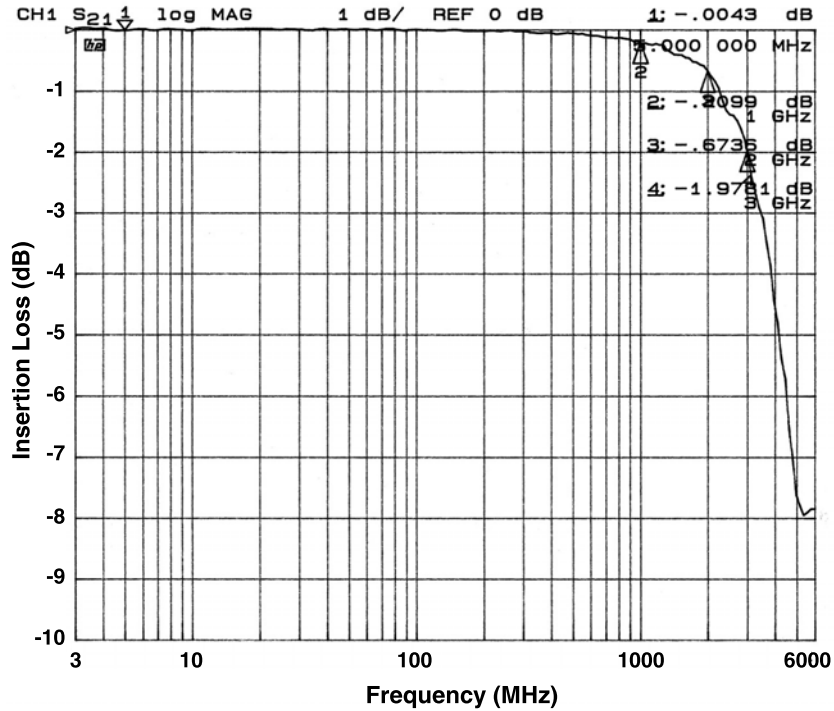
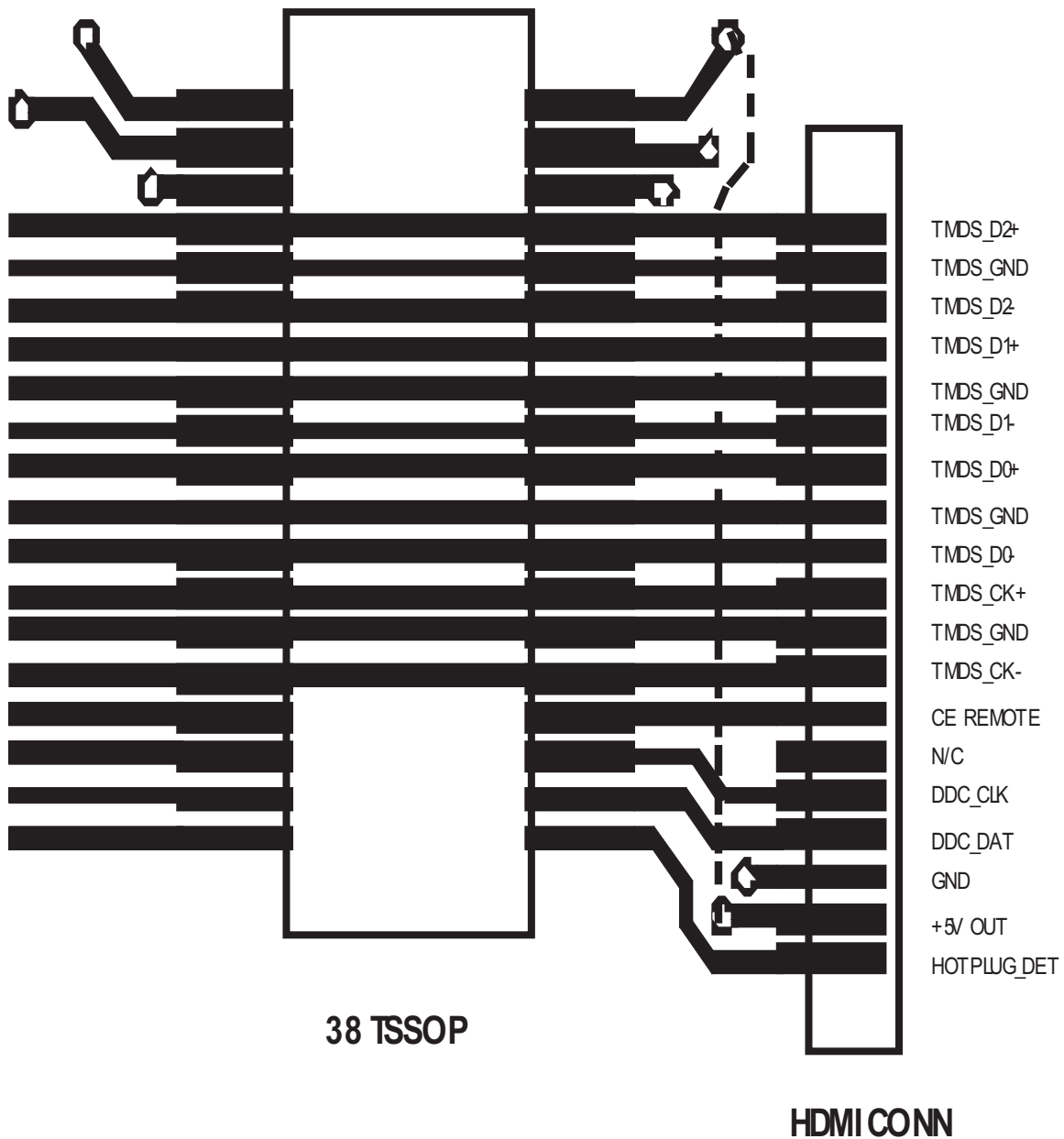


Figure 1. Insertion Loss vs. Frequency (TMS\_D1- to GND)

**Application Information**



**Figure 2. Typical Application for CM2020**

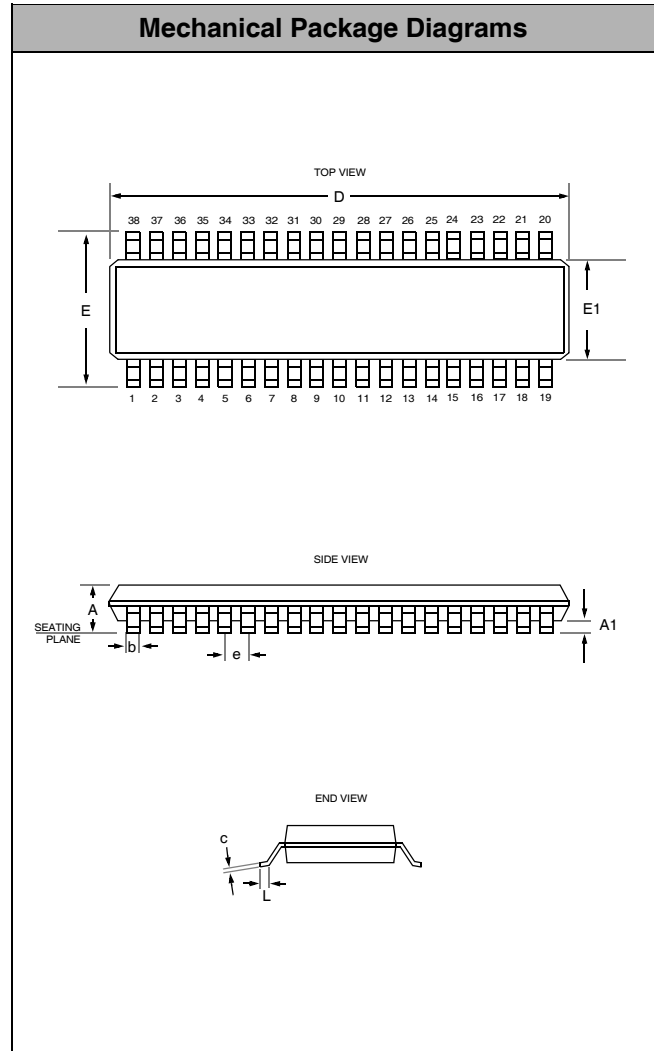
## Mechanical Details

### TSSOP-38 Mechanical Specifications

CM2020 devices are supplied in 38-pin TSSOP packages. Dimensions are presented below.

For complete information on the TSSOP-38, see the California Micro Devices TSSOP Package Information document.

| PACKAGE DIMENSIONS                 |                         |      |           |       |
|------------------------------------|-------------------------|------|-----------|-------|
| Package                            | TSSOP                   |      |           |       |
| JEDEC No.                          | MO-153 (Variation BD-1) |      |           |       |
| Pins                               | 38                      |      |           |       |
| Dimensions                         | Millimeters             |      | Inches    |       |
|                                    | Min                     | Max  | Min       | Max   |
| A                                  | —                       | 1.20 | —         | 0.047 |
| A1                                 | 0.05                    | 0.15 | 0.002     | 0.006 |
| b                                  | 0.17                    | 0.27 | 0.007     | 0.011 |
| c                                  | 0.09                    | 0.20 | 0.004     | 0.008 |
| D                                  | 9.60                    | 9.80 | 0.378     | 0.386 |
| E                                  | 6.40 BSC                |      | 0.252 BSC |       |
| E1                                 | 4.30                    | 4.50 | 0.169     | 0.177 |
| e                                  | 0.50 BSC                |      | 0.020 BSC |       |
| L                                  | 0.45                    | 0.75 | 0.018     | 0.030 |
| # per tape and reel                | 2500 pieces             |      |           |       |
| Controlling dimension: millimeters |                         |      |           |       |



Package Dimensions for TSSOP-38