# EST.393M
# Dual Differential Comparator

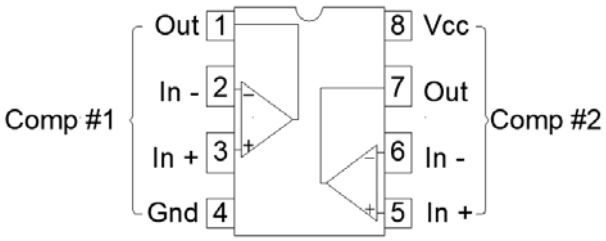
## GENERAL DESCRIPTION

The EST.393M consists of two independent voltage comparators. These were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

## FEATURES

- Low supply current drain independent of the supply voltage.
- Low input biasing current
- Low input offset current
- Low input offset voltage
- Input common-mode voltage range includes GND
- Differential input voltage range equal to the power supply voltage
- Low output saturation voltage
- Output voltage compatible with TTL, MOS and CMOS logic

## PIN ARRANGEMENT




DIP-8 L

SOP-8L

## ORDERING INFORMATION

| Device | Temperature Range | Package | Packaging |
|---|---|---|---|
| EST.393M | 0℃ to +70℃ | DIP-8 | Tube |
| EST.393MS | 0℃ to +70℃ | SOP-8 | Tape & Reel |

Note: EST lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. EST lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020C for MSL classification at lead-free peak reflow temperature. EST defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight)

## CIRCUIT SCHEMATIC

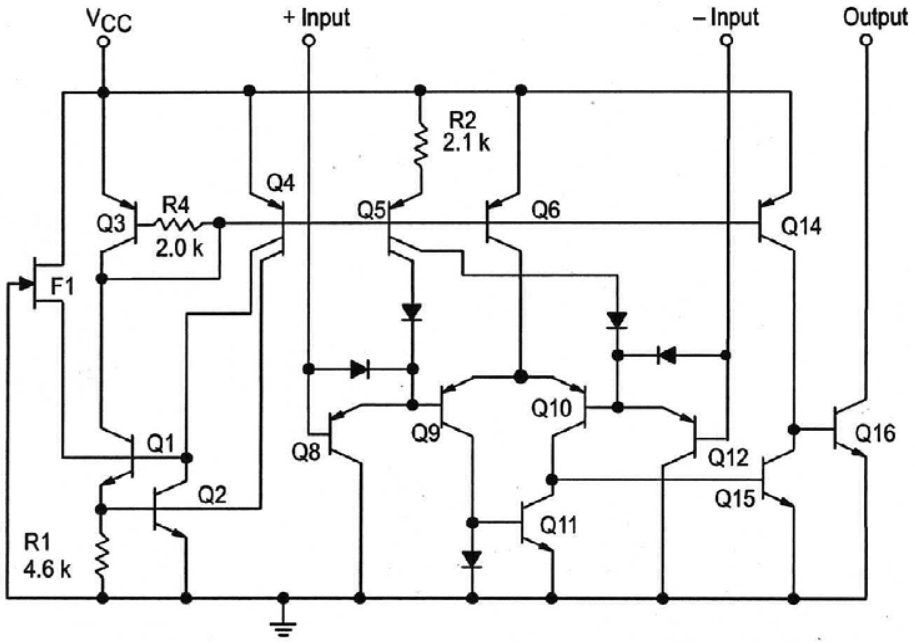



**Diagram shown is for 1 comparator**

## ELECTRICAL CHARACTERISTICS

at specified free-air temperature, VCC=5V (unless otherwise noted)

| Item | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Input Offset Voltage (2)<br>TA=25℃<br>0 ℃≤TA ≤ 70 ℃ | VIO | ---<br>--- | ±2.0<br>--- | ±5.0<br>9.0 | mV |
| Input Offset Current<br>TA=25℃<br>0 ℃≤TA ≤ 70 ℃ | IIO | ---<br>--- | ±5.0<br>--- | ±50<br>±150 | nA |
| Input Offset Current (3)<br>TA=25℃<br>0 ℃≤TA ≤ 70 ℃ | IIB | ---<br>--- | -25<br>--- | -250<br>-400 | nA |
| Input Common Mode Voltage Range (3)<br>TA=25℃<br>0 ℃≤TA ≤ 70 ℃ | VICR | 0<br>0 | ---<br>--- | VCC-1.5<br>VCC-2.0 | V |
| Voltage Gain RL ≥ 15K, VCC=15Vdc, TA=25℃ | AVOL | 50 | 200 | --- | V/mV |
| Large Signal Response Time Vin=TTL Logic Swing,Vref=1.4 Vdc VRL=5.0Vdc, RL=5.1K, TA=25℃ | --- | --- | 300 | --- | ns |
| Response Time (5) VRL=5.0Vdc, RL=5.1K, TA=25℃ | tTLH | --- | 1.3 | --- | μs |
| Input Differential Voltage (6) All Vin≥ GND or V-Supply (if used) | VID | --- | --- | VCC | V |

| | | | | | |
|---|---|---|---|---|---|
| Output Sink Current<br>Vin-≥ 1.0Vdc, Vin+=0Vdc Vo≤ 1.5Vdc, $T_A$=25℃ | $I_{sink}$ | 6.0 | 16 | --- | mA |
| Output Saturation Voltage<br>Vin-≥ 1.0Vdc,Vin+=0,ISink ≤ 4.0mA<br>$T_A$=25℃<br>0 ℃≤TA ≤ 70 ℃ | $V_{OL}$ | <br><br>---<br>--- | <br><br>150<br>--- | <br><br>400<br>700 | mV |
| Output Leakage Current<br>Vin-=0Vdc, Vin+ ≥ 1.0Vdc<br>Vo=5.0Vdc, $T_A$=25℃<br>Vin-=0Vdc, Vin+ ≥ 1.0Vdc<br>Vo=30Vdc, 0 ℃≤TA ≤ 70 ℃ | $I_{OL}$ | <br><br>---<br><br>--- | <br><br>0.1<br><br>--- | <br><br>---<br><br>1000 | nA |
| Supply Current<br>RL=∞, $T_A$=25℃<br>RL=∞, VCC=30V℃ | $L_{CC}$ | <br>---<br>--- | <br>0.4<br>--- | <br>1.0<br>2.5 | mA |

*Full range (MIN to MAX), for the 393MK is -40C to 125C. All characteristics are measured with zero common-mode input voltage unless otherwise specified.

**The voltage at either input or common-mode should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is VCC-1.5V, but either or both inputs can go to 30V without damage.

## ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Power Supply Voltage | $V_{CC}$ | +30 ±15 | V |
| Input Differential Voltage Range | $V_{IDR}$ | 30 | V |
| Input Common Mode Voltage Range | $V_{ICR}$ | -0.3 to +30 | V |
| Output Short Circuit-to-Ground<br>Output Sink Current (1) | $I_{SC}$<br>$I_{Sink}$ | Continuous<br>20 | mA |
| Power Dissipation @25℃<br>Derate above25℃ | $P_D$<br>$1/R_{\theta JA}$ | 570<br>5.7 | Mw<br>mW/℃ |
| Operating Ambient Temperature Range | $T_A$ | 0 to +70 | ℃ |
| Operating Junction Temperature | $T_J$ | 125 | ℃ |
| Storage Temperature Range | $T_S$ | -65 to 150 | ℃ |

Notes:

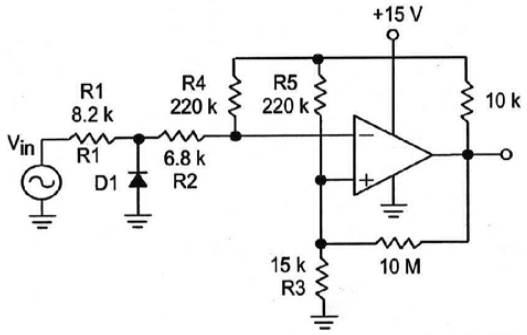
1. The max output current may be as high as 20mA, independent of the magnitude of VCC, output short circuits to VCC can cause excessive heating and eventual destruction.
2. At output switch point, VO=1.4Vdc, RS=0 with VCC from 5.0Vdc to 30Vdc, and over the full input common mode range (0V to VCC=-1.5V).
3. Due to the PNP transistor inputs, bias current will flow out of the inputs. This current is essentially constant,independent of the output state, therefore, no loading changes will exist on the input lines.
4. Input common mode of either input should not be permitted to go more than 0.3V negative of ground or minus supply. The upper limit of common mode range is VCC –1.5V.
5. Response time is specified with a 100mV step and 5.0mV of overdrive. With larger magnitudes of overdrive faster response times are obtainable.
6. The comparator will exhibit proper output state if one of the inputs becomes greater than VCC, the other input must remain within the common mode range. The low input state must not be less than –0.3V of ground or minus supply.

## APPLICATION INFORMATION

These dual comparators feature high gain, wide bandwidth characteristics. This gives the device oscillation tendencies if the outputs are capacitively coupled to the inputs via stray capacitance. This oscillation manifests itself during output transitions (VOL to VOH).To alleviate this situation, input resistors<10kΩ should be used.

The addition of positive feedback (<10mV) is also recommended. It is good design practice to ground all unused pins.

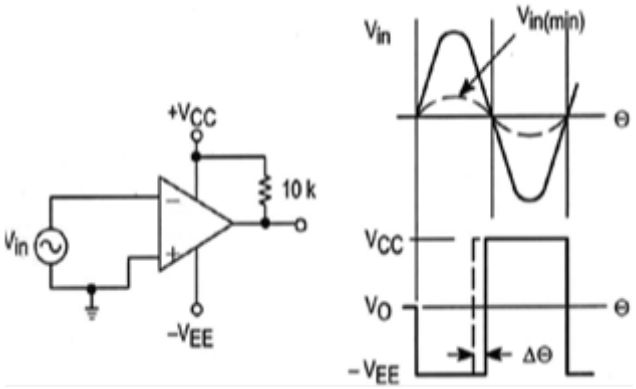
Differential input voltages may be larger than supply voltage without damaging the comparator's inputs. Voltages more negative than –0.3V should not be used.




D1 prevents input from going negative by more than 0.6V,R1+R2=R3

R3≤$\frac{R5}{10}$ for small error in zero crossing.

**Fig 1. Zero Crossing Detector (single supply)**




Vin(min)≈0.4V peak for 1% phase distortion(△⊙)

**Fig 2. Zero Crossing Detector (split supply)**

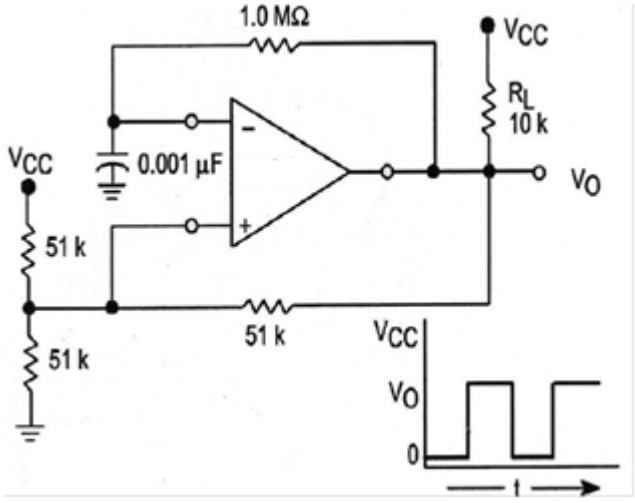



**Fig 3. Free-Running Square Wave Oscillator**

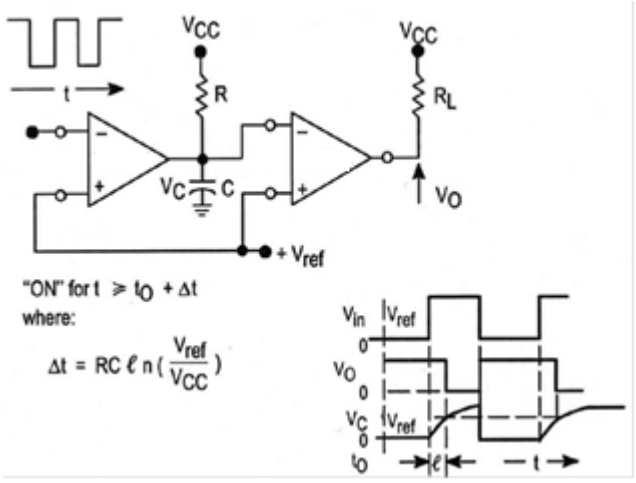



**Fig 4.Time Delay Generator**

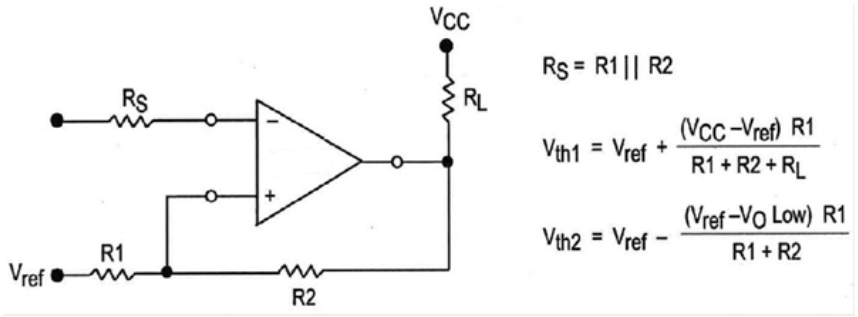



**Fig 5. Comparator With Hysteresis**

## ELECTRICAL CHARACTERISTICS CURVES

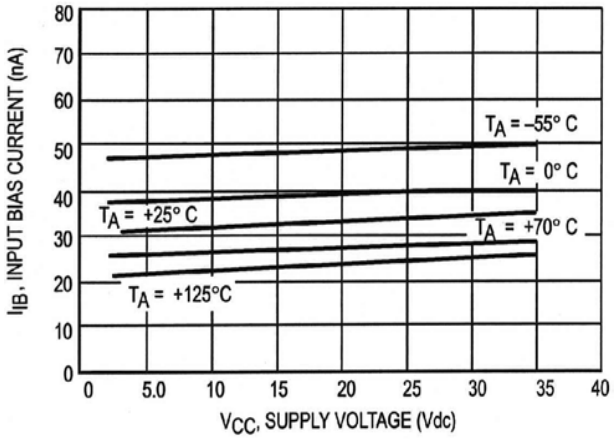



**Fig 6. Input bias current versus power Supply voltage**

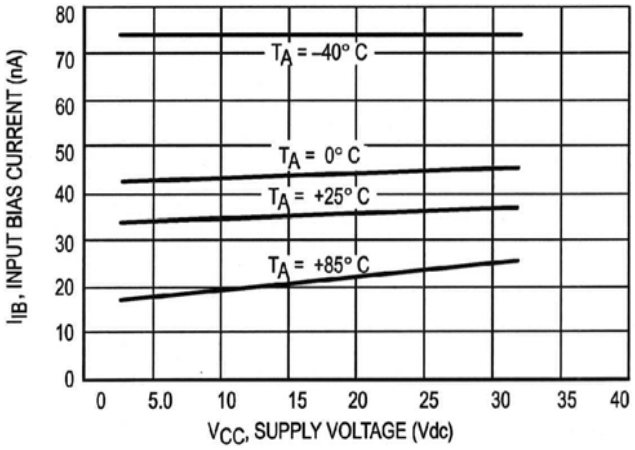



**Fig 7. Output saturation voltage versus output sink current**

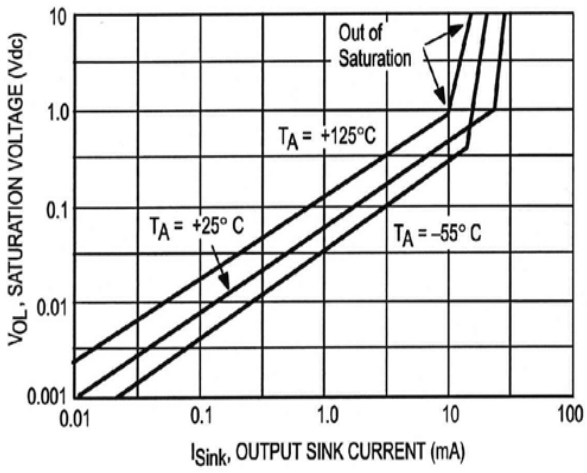



**Fig 8. Output Saturation Voltage versus Output Sink Current**

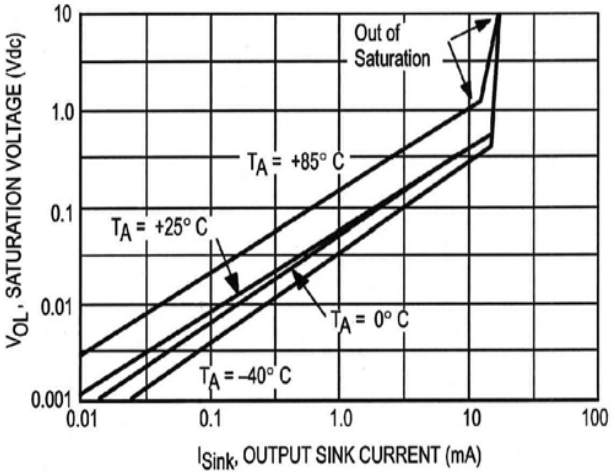



**Fig 9. Output Saturation Voltage versus Output Sink Current**

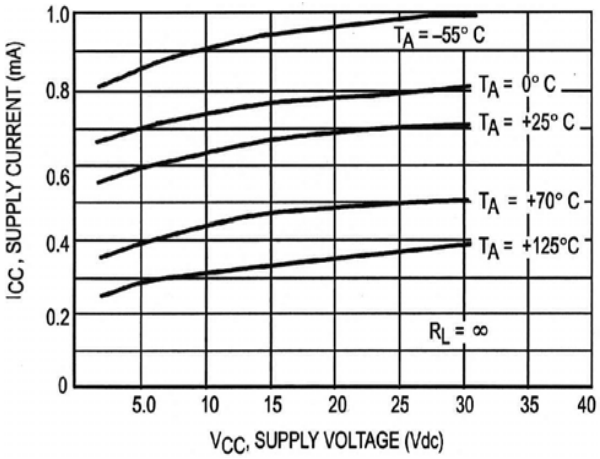



**Fig 10. Power Supply Current versus Power Supply Voltage**

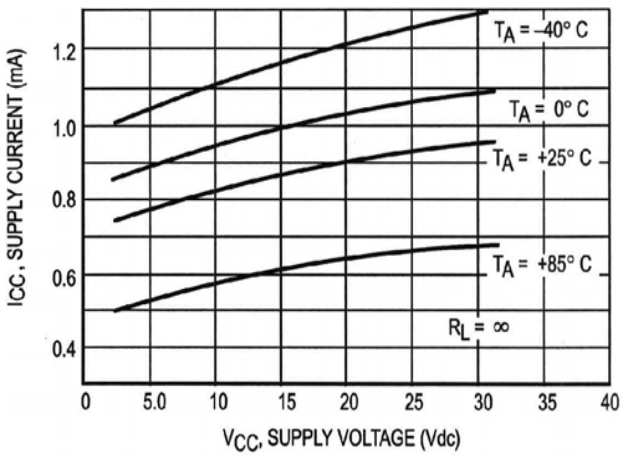
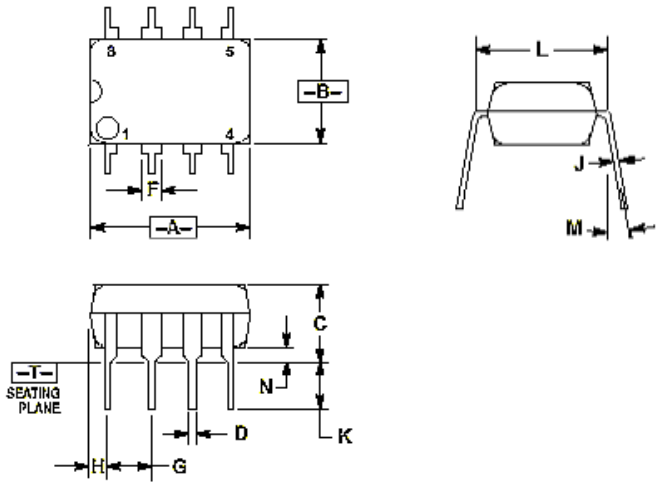



**Fig 11. Power Supply Current versus Power Supply Voltage**

## EXTERNAL DIMENSIONS

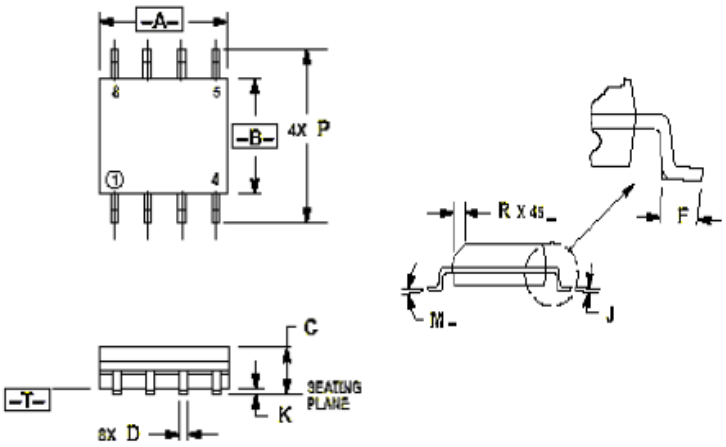
### DIP-8

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 9.20 | 9.80 | 0.362 | 0.386 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.20 | 3.80 | 0.126 | 0.150 |
| D | 0.38 | 0.51 | 0.015 | 0.020 |
| F | 1.02 | 1.78 | 0.040 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.76 | 1.27 | 0.030 | 0.050 |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | -- | 10° | -- | 10° |
| N | 0.76 | 1.01 | 0.030 | 0.040 |



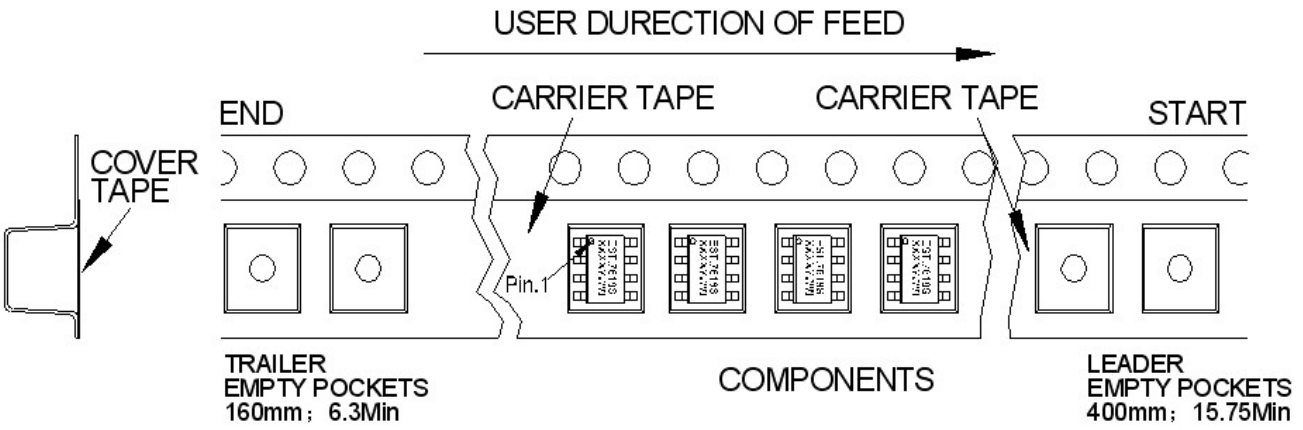

### SOP-8

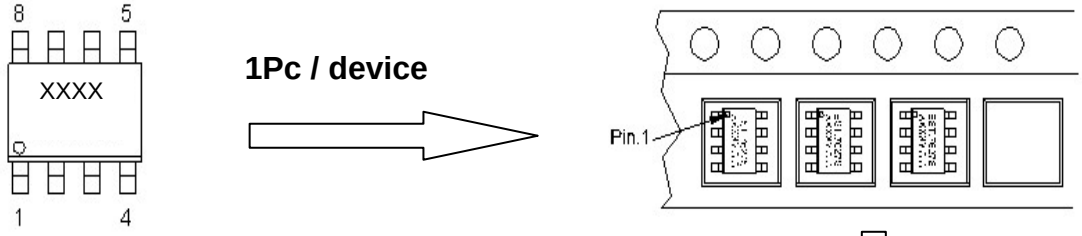
| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 5.00 | 5.20 | 0.196 | 0.205 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.18 | 0.25 | 0.007 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |



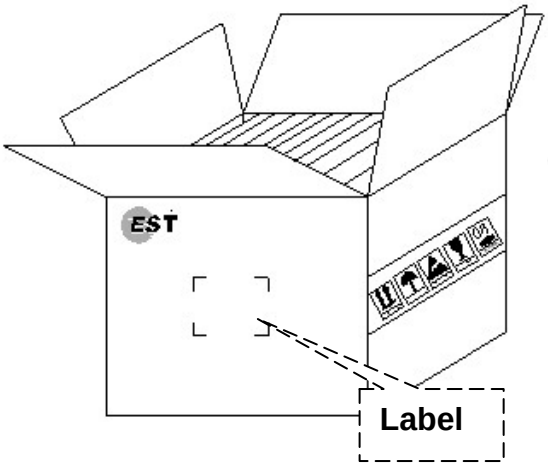
## Shipping packing :

**★SOP-8 tape & Reel:**

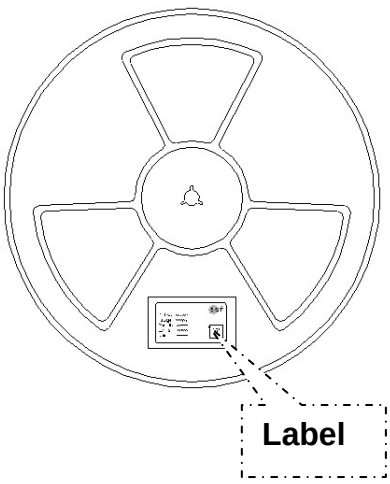


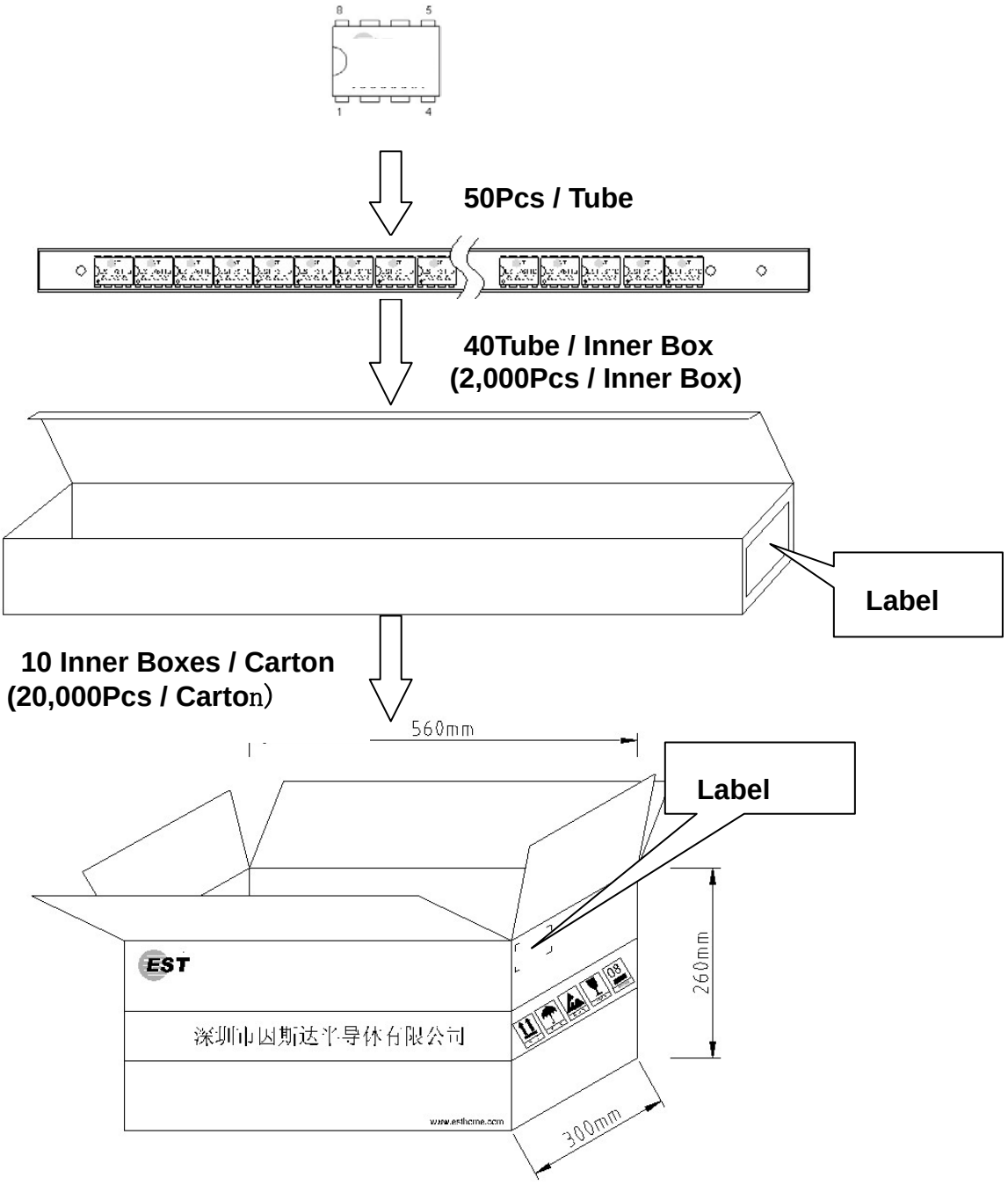

**3000 devices / Reel**




**10 Reel / Carton**
**(30,000Pcs / Carton)**



★DIP-8:


50Pcs / Tube
40Tube / Inner Box
(2,000Pcs / Inner Box)
Label
10 Inner Boxes / Carton
(20,000Pcs / Carton)
560mm
Label
260mm
300mm
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