

TC74VHC393F, TC74VHC393FN, TC74VHC393FT

DUAL BINARY COUNTER

The TC74VHC393 is an advanced high speed CMOS 4-BIT BINARY COUNTER fabricated with silicon gate C²MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

It contains two independent counter circuits in one package, so that counting or frequency division of eight binary bits can be achieved with one IC.

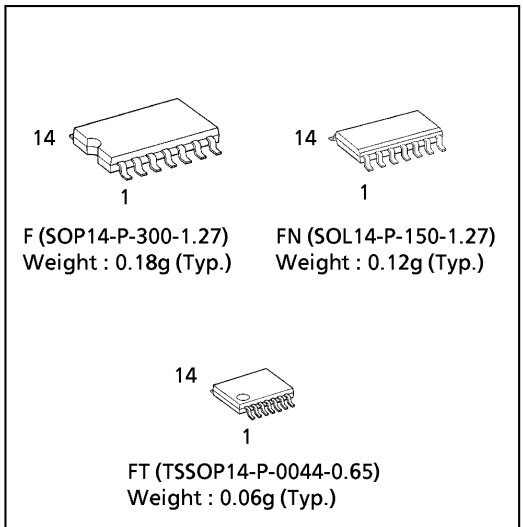
This device changes state on the negative going transition of the CLOCK pulse. The counter can be reset to "0" (QA~QD="L") by a high at the CLEAR input regardless of other inputs.

An input protection circuit ensures that 0 to 5.5V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

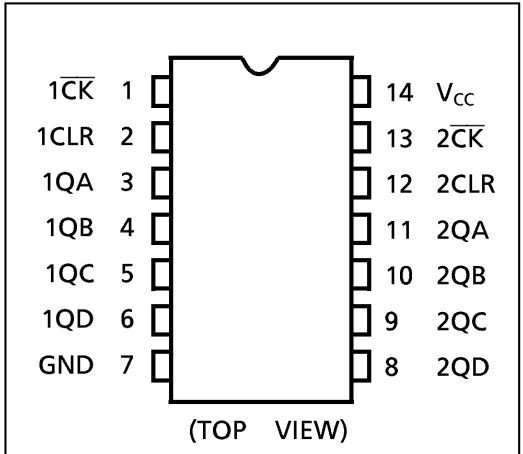
FEATURES:

- High Speed..... $f_{MAX} = 170\text{MHz}(\text{typ.})$
at $V_{CC} = 5\text{V}$
- Low Power Dissipation..... $I_{CC} = 4\mu\text{A}(\text{Max.})$ at $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{NIH} = V_{NIL} = 28\% V_{CC} (\text{Min.})$
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays..... $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range..... $V_{CC} (\text{opr}) = 2\text{V} \sim 5.5\text{V}$
- Low Noise $V_{OLP} = 0.8\text{V} (\text{Max.})$
- Pin and Function Compatible with 74ALS393

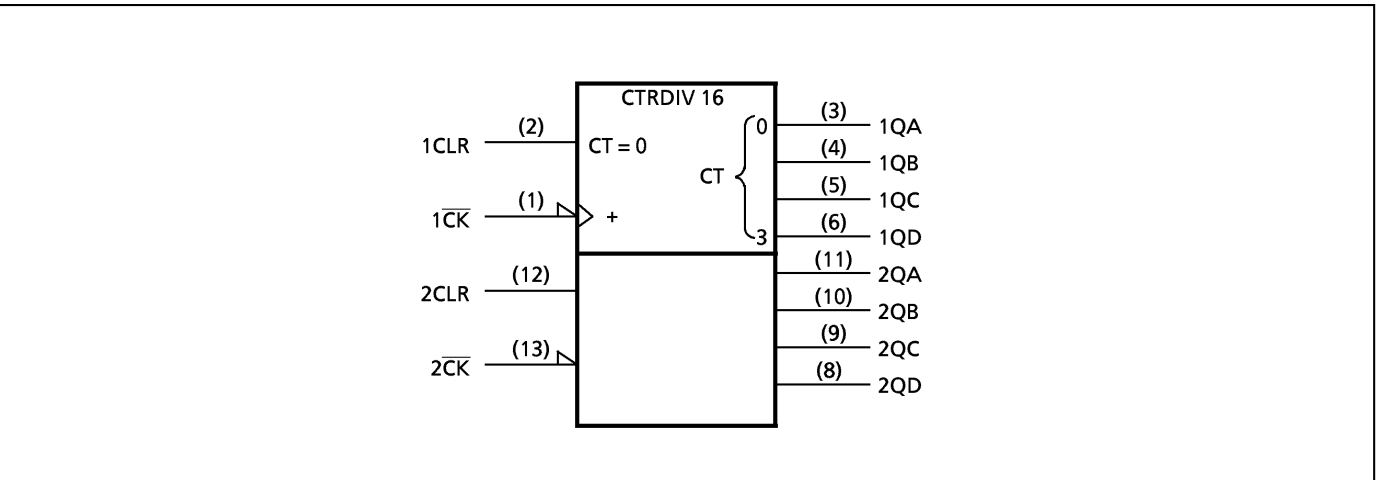
(Note) The JEDEC SOP (FN) is not available in Japan.





PIN ASSIGNMENT



IEC LOGIC SYMBOL

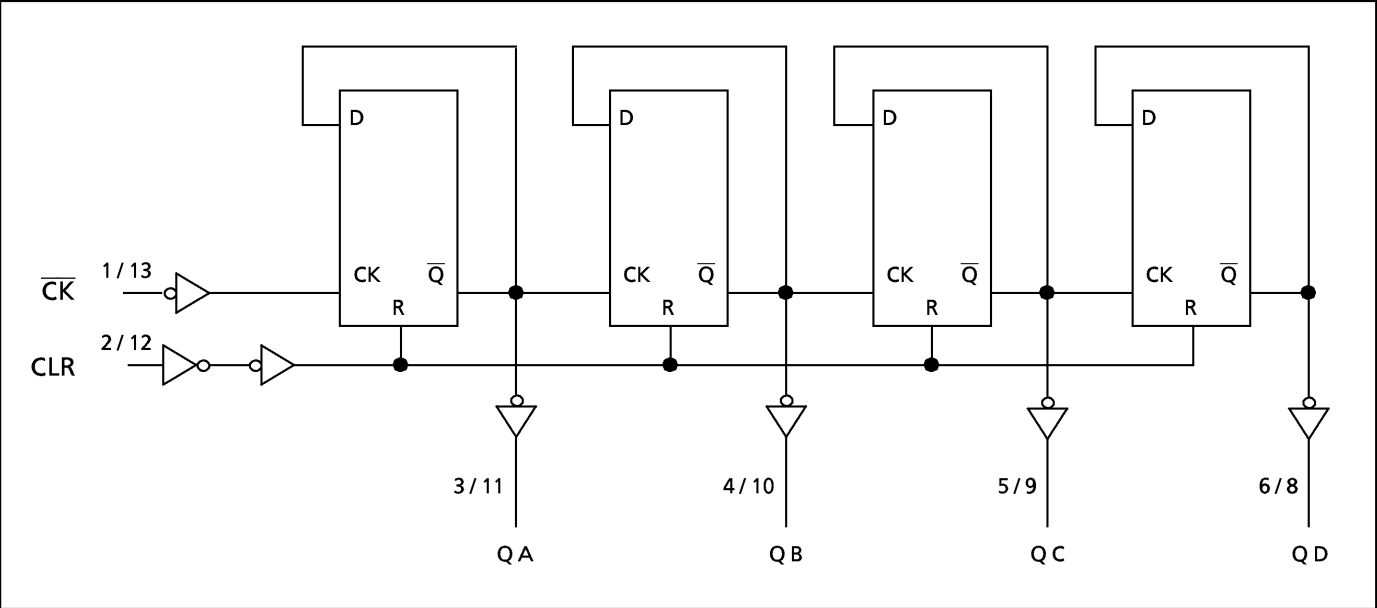


TRUTH TABLE

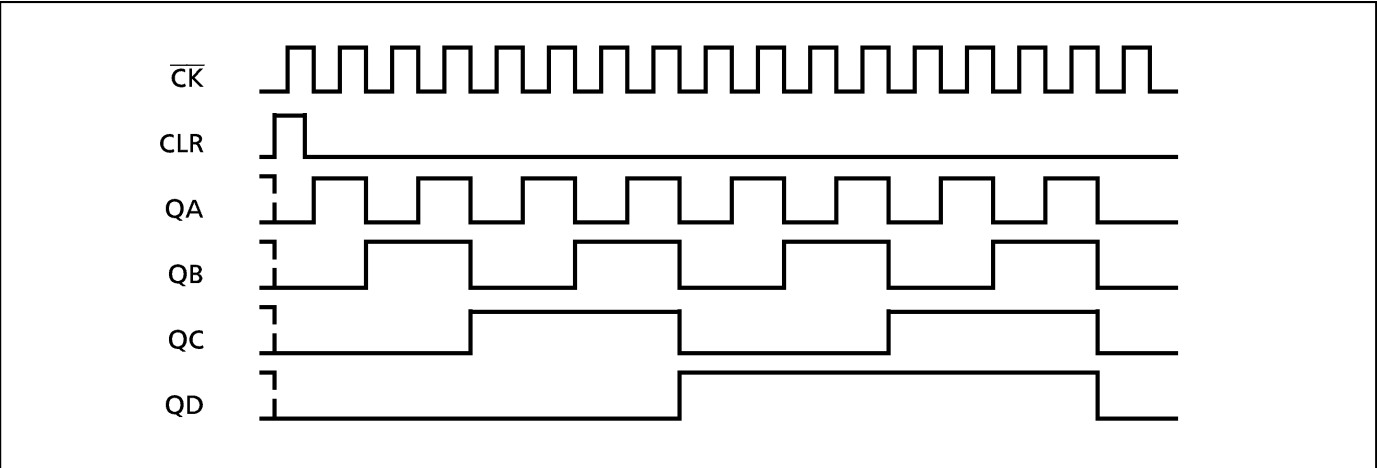
| INPUTS | | OUTPUTS | | | |
|-----------------------------------------------------------------------------------|-----|-----------|----|----|----|
| \overline{CK} | CLR | QA | QB | QC | QD |
| X | H | L | L | L | L |
|  | L | COUNT UP | | | |
|  | L | NO CHANGE | | | |

X : Don't Care

SYSTEM DIAGRAM



TIMING CHART



ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | VALUE | UNIT |
|-----------------------------|-----------|----------------------|------|
| Supply Voltage Range | V_{CC} | -0.5~7.0 | V |
| DC Input Voltage | V_{IN} | -0.5~7.0 | V |
| DC Output Voltage | V_{OUT} | -0.5~ $V_{CC} + 0.5$ | V |
| Input Diode Current | I_{IK} | -20 | mA |
| Output Diode Current | I_{OK} | ± 20 | mA |
| DC Output Current | I_{OUT} | ± 25 | mA |
| DC V_{CC} /Ground Current | I_{CC} | ± 75 | mA |
| Power Dissipation | P_D | 180 | mW |
| Storage Temperature | T_{stg} | -65~150 | °C |

RECOMMENDED OPERATING CONDITIONS

| PARAMETER | SYMBOL | VALUE | UNIT |
|--------------------------|-----------|---------------------------------------------------------------------|------|
| Supply Voltage | V_{CC} | 2.0~5.5 | V |
| Input Voltage | V_{IN} | 0~5.5 | V |
| Output Voltage | V_{OUT} | 0~ V_{CC} | V |
| Operating Temperature | T_{opr} | -40~85 | °C |
| Input Rise and Fall Time | dt/dv | 0~100 ($V_{CC} = 3.3 \pm 0.3V$) 0~20 ($V_{CC} = 5 \pm 0.5V$) | ns/V |

DC ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | TEST CONDITION | V_{CC} (V) | $T_a = 25^\circ C$ | | | $T_a = -40 \sim 85^\circ C$ | | UNIT | |
|-----------------------------|----------|-------------------------------|------------------------------------|---------------------|------------|---------------------|-----------------------------|---------------------|------------|---|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | | |
| High - Level Input Voltage | V_{IH} | | 2.0 | 1.50 | — | — | 1.50 | — | V | |
| | | | 3.0~5.5 | $V_{CC} \times 0.7$ | — | — | $V_{CC} \times 0.7$ | — | | |
| Low - Level Input Voltage | V_{IL} | | 2.0 | — | — | 0.50 | — | 0.50 | V | |
| | | | 3.0~5.5 | — | — | $V_{CC} \times 0.3$ | — | $V_{CC} \times 0.3$ | | |
| High - Level Output Voltage | V_{OH} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OH} = -50 \mu A$ | 2.0 | 1.9 | 2.0 | — | 1.9 | — | V |
| | | | $I_{OH} = -4mA$ $I_{OH} = -8mA$ | 3.0 4.5 | 2.9 4.4 | 3.0 4.5 | — — | 2.9 4.4 | — — | |
| Low - Level Output Voltage | V_{OL} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 50 \mu A$ | 2.0 | — | 0.0 | 0.1 | — | 0.1 | V |
| | | | $I_{OL} = 4mA$ $I_{OL} = 8mA$ | 3.0 4.5 | — — | 0.0 0.0 | 0.1 0.1 | — — | 0.1 0.1 | |
| Input Leakage Current | I_{IN} | $V_{IN} = 5.5V$ or GND | 0~5.5 | — | — | ± 0.1 | — | ± 1.0 | μA | |
| Quiescent Supply Current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 5.5 | — | — | 4.0 | — | 40.0 | | |

TIMING REQUIREMENTS (Input $t_r = t_f = 3ns$)

| PARAMETER | SYMBOL | TEST CONDITION | Ta = 25°C | | | Ta = -40~85°C | UNIT |
|--------------------------------------------|--------------------------|----------------|---------------------|------|-------|---------------|------|
| | | | V _{CC} (V) | TYP. | LIMIT | LIMIT | |
| Minimum Pulse Width (\overline{CK}) | $t_{W(H)}$ $t_{W(L)}$ | | 3.3 ± 0.3 | — | 5.0 | 5.0 | ns |
| | | | 5.0 ± 0.5 | — | 5.0 | 5.0 | |
| Minimum Pulse Width (CLR) | $t_{W(H)}$ | | 3.3 ± 0.3 | — | 5.0 | 5.0 | |
| | | | 5.0 ± 0.5 | — | 5.0 | 5.0 | |
| Minimum Removal Time | t_{rem} | | 3.3 ± 0.3 | — | 5.0 | 5.0 | |
| | | | 5.0 ± 0.5 | — | 4.0 | 4.0 | |

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3ns$)

| PARAMETER | SYMBOL | TEST CONDITION | | Ta = 25°C | | | Ta = -40~85°C | | UNIT |
|---------------------------------------------------|------------------------|---------------------|---------|-----------|------|------|---------------|------|------|
| | | V _{CC} (V) | CL (pF) | MIN. | TYP. | MAX. | MIN. | MAX. | |
| Propagation Delay Time (\overline{CK} - QA) | t_{pLH} t_{pHL} | 3.3 ± 0.3 | 15 | — | 8.6 | 13.2 | 1.0 | 15.5 | ns |
| | | | 50 | — | 11.1 | 16.7 | 1.0 | 19.0 | |
| | | 5.0 ± 0.5 | 15 | — | 5.8 | 8.5 | 1.0 | 10.0 | |
| | | | 50 | — | 7.3 | 10.5 | 1.0 | 12.0 | |
| Propagation Delay Time (\overline{CK} - QB) | t_{pLH} t_{pHL} | 3.3 ± 0.3 | 15 | — | 10.2 | 15.8 | 1.0 | 18.5 | |
| | | | 50 | — | 12.7 | 19.3 | 1.0 | 22.0 | |
| | | 5.0 ± 0.5 | 15 | — | 6.8 | 9.8 | 1.0 | 11.5 | |
| | | | 50 | — | 8.3 | 11.8 | 1.0 | 13.5 | |
| Propagation Delay Time (\overline{CK} - QC) | t_{pLH} t_{pHL} | 3.3 ± 0.3 | 15 | — | 11.7 | 18.0 | 1.0 | 21.0 | |
| | | | 50 | — | 14.2 | 21.5 | 1.0 | 24.5 | |
| | | 5.0 ± 0.5 | 15 | — | 7.7 | 11.2 | 1.0 | 13.0 | |
| | | | 50 | — | 9.2 | 13.2 | 1.0 | 15.0 | |
| Propagation Delay Time (\overline{CK} - QD) | t_{pLH} t_{pHL} | 3.3 ± 0.3 | 15 | — | 13.0 | 19.7 | 1.0 | 23.0 | |
| | | | 50 | — | 15.5 | 23.2 | 1.0 | 26.5 | |
| | | 5.0 ± 0.5 | 15 | — | 8.5 | 12.5 | 1.0 | 14.5 | |
| | | | 50 | — | 10.0 | 14.5 | 1.0 | 16.5 | |
| Propagation Delay Time (CLR - Qn) | t_{pHL} | 3.3 ± 0.3 | 15 | — | 7.9 | 12.3 | 1.0 | 14.5 | |
| | | | 50 | — | 10.4 | 15.8 | 1.0 | 18.0 | |
| | | 5.0 ± 0.5 | 15 | — | 5.4 | 8.1 | 1.0 | 9.5 | |
| | | | 50 | — | 6.9 | 10.1 | 1.0 | 11.5 | |
| Maximum Clock Frequency | f_{MAX} | 3.3 ± 0.3 | 15 | 75 | 120 | — | 65 | — | MHZ |
| | | | 50 | 45 | 65 | — | 35 | — | |
| | | 5.0 ± 0.5 | 15 | 125 | 170 | — | 105 | — | |
| | | | 50 | 85 | 115 | — | 75 | — | |
| Input Capacitance | C_{IN} | | | — | 4 | 10 | — | 10 | pF |
| Power Dissipation Capacitance | C_{PD} | Note (1) | | — | 23 | — | — | — | |

Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

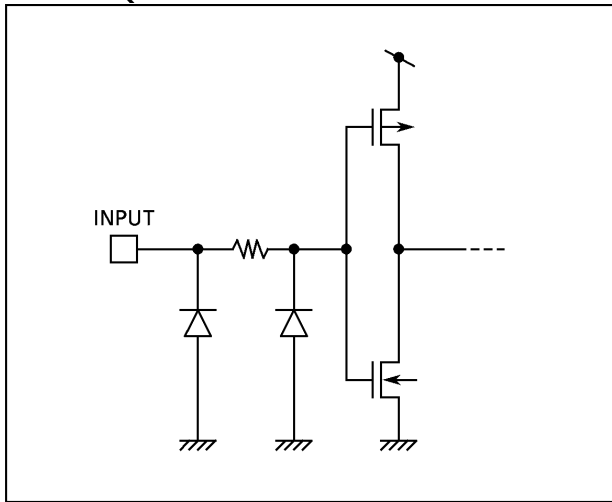
Average operating current can be obtained by the equation :

$$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2 \text{ (per counter)}$$

NOISE CHARACTERISTICS (Input $t_r = t_f = 3ns$)

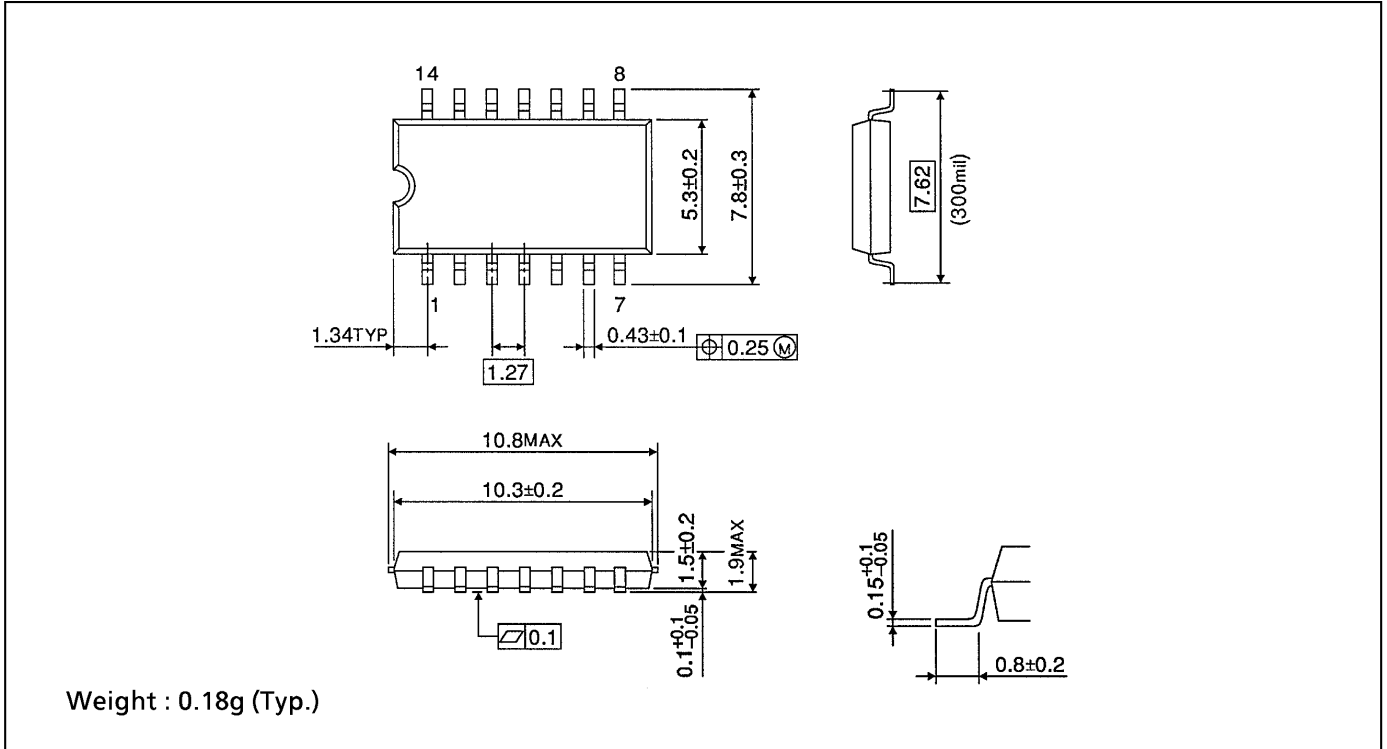
| PARAMETER | SYMBOL | TEST CONDITION | Ta = 25°C | | UNIT |
|----------------------------------------------|------------------|-----------------------|---------------------|-------------|------|
| | | | V _{CC} (V) | TYP. / MAX. | |
| Quiet Output Maximum Dynamic V _{OL} | V _{OLP} | C _L = 50pF | 5.0 | 0.5 / 0.8 | V |
| Quiet Output Minimum Dynamic V _{OL} | V _{OLV} | C _L = 50pF | 5.0 | -0.5 / -0.8 | V |
| Minimum High Level Dynamic Input Voltage | V _{IHD} | C _L = 50pF | 5.0 | - / 3.5 | V |
| Maximum Low Level Dynamic Input Voltage | V _{ILD} | C _L = 50pF | 5.0 | - / 1.5 | V |

INPUT EQUIVALENT CIRCUIT



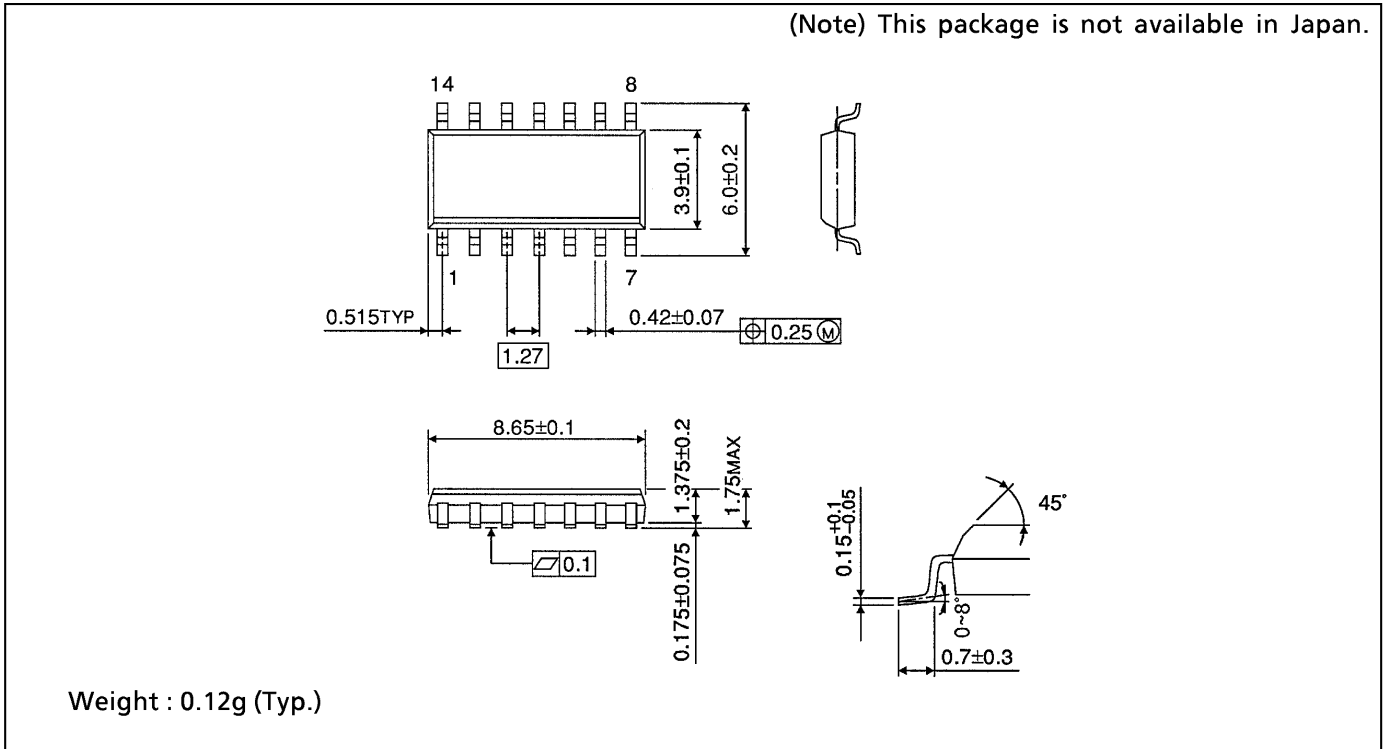
SOP 14PIN (200mil BODY) PACKAGE DIMENSIONS (SOP14-P-300-1.27)

Unit in mm



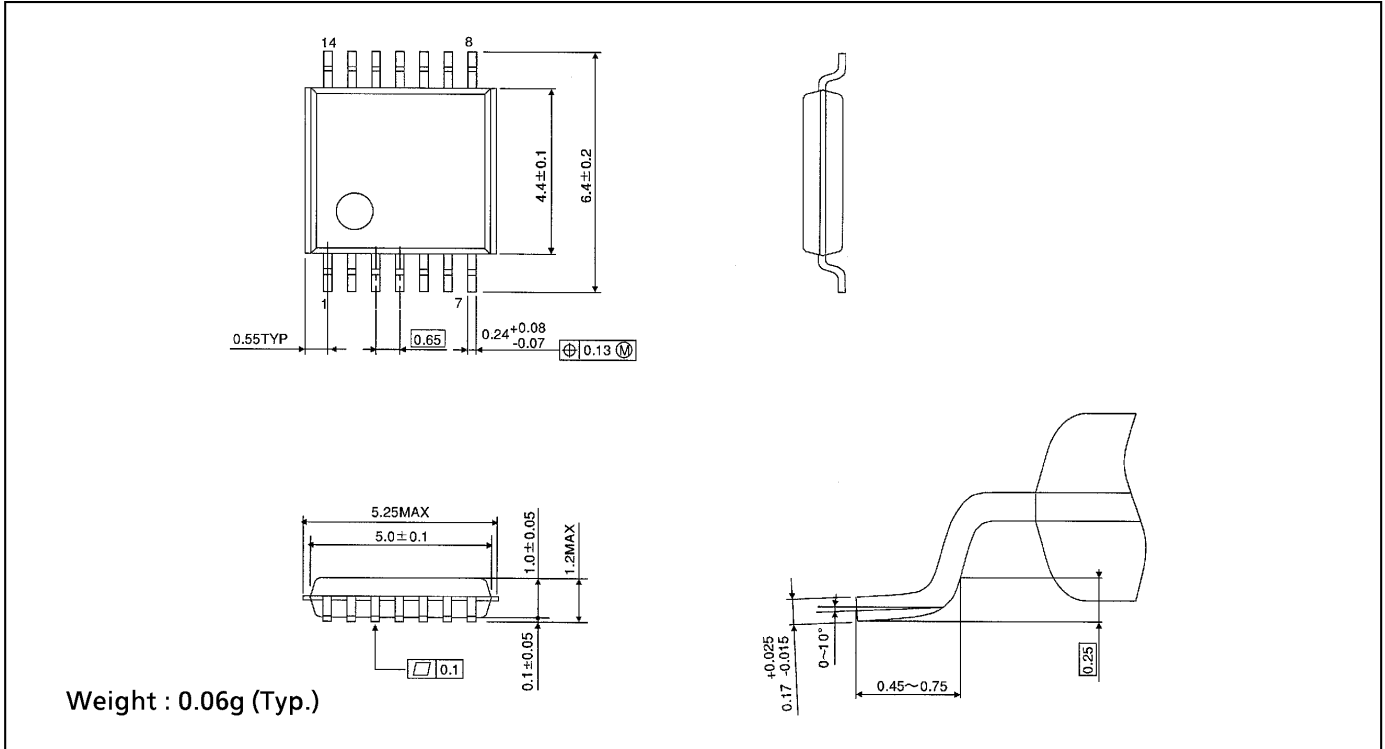
SOP 14PIN (150mil BODY) PACKAGE DIMENSIONS (SOP14-P-150-1.27)

Unit in mm



TSSOP 14PIN PACKAGE DIMENSIONS (TSSOP14-P-0044-0.65)

Unit in mm



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