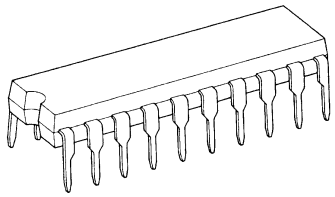
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC9243P,TC9243F

## Infrared Remote Control Signal Transmission LSI

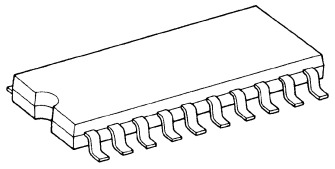
The TC9243P, TC9243F are infrared remote control signal transmission LSI which is suited for remote control of audio system, TV, VTR, CD player, etc.

TC9243P



DIP20-P-300-2.54A

TC9243F



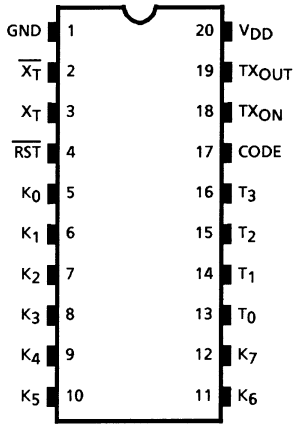
SOP20-P-300-1.27

Weight
DIP20-P-300-2.54A: 1.4 g (typ.)
SOP20-P-300-1.27: 0.48 g (typ.)

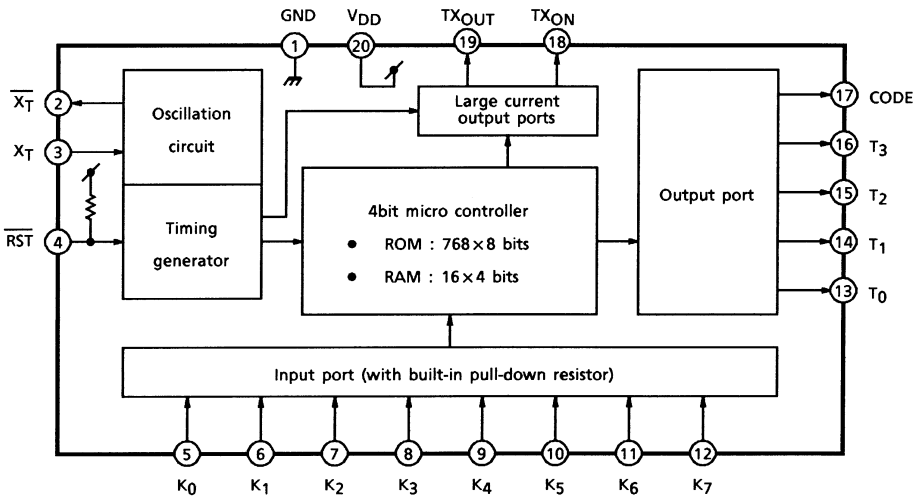
### Features

- Wide range of operating supply voltages, enabling low voltage operation.
  : $V_{DD}$ = 2.0~4.0 V
- 32 functions are basically available.
  Up to 112 instructions (28 × 4) can be output because multiple keying is possible.
- Interference with other equipment is prevented because 7 bits out of 8 bits of system code are presettable.
- With transmission display output pin.
- Low current dissipation.: $I_{QD} \leq 1$ μA (at time of standby)
- Packages in two types; DIP and flat types are available.
  DIP20: TC9243P
  SOP20: TC9243F

### Pin Assignment



## Block Diagram



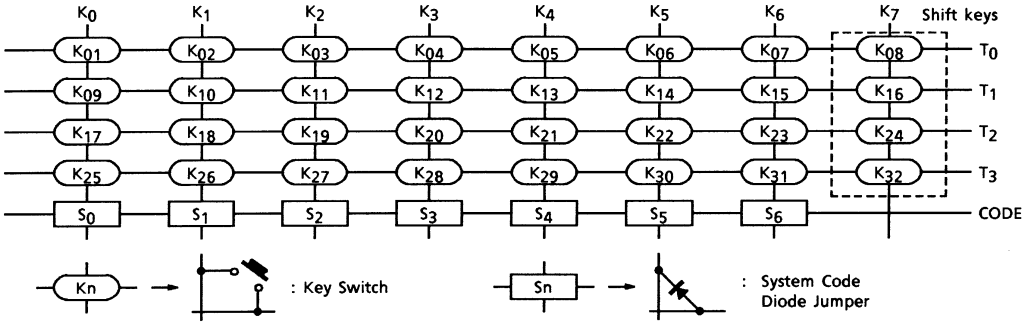

## Pin Function

| Pin No. | Symbol | Pin Name | Function and Operation |
|---|---|---|---|
| 1 | GND | Power Terminal | Applies supply voltage. ($V_{DD}$ = 2.0~4.0 V) |
| 20 | $V_{DD}$ | | |
| 2 | $\overline{X_T}$ | Oscillator Terminal | Input/output terminals for the ceramic oscillators, with built-in amplifier circuit and feedback resistor. |
| 3 | $X_T$ | | |
| 4 | $\overline{RST}$ | Reset Input | When this pin is set at “L” level, the inside is initialized.<br>With a built-in pull-up resistor. |
| 5~12 | $K_0$~$K_7$ | Key Inputs | The input terminals for Key Matrix.<br>Each of all the pins has a built-in pull-down resistor. |
| 13~16 | $T_0$~$T_3$ | Key Scan Output | The key matrix scan output terminals.<br>CMOS output. |
| 17 | CODE | Code Scan Output | The scan output terminals for code setting.<br>Pch open drain output. |
| 18 | $TX_{ON}$ | Transmission Display Output | Transmission display LED driving output terminal. |
| 19 | $TX_{OUT}$ | Transmission Output | Infrared LED driving output terminal. |

## Operations

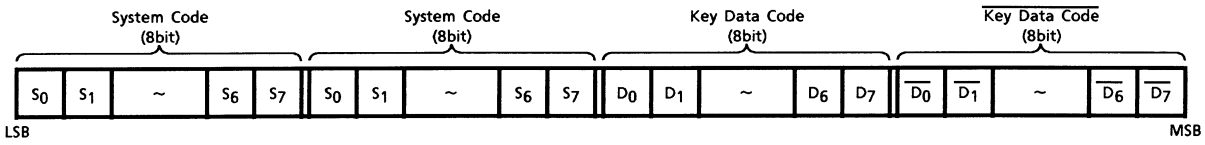
### 1. Key Matrix

The TC9243P, TC9243F enables the setting of maximum 32 keys in combination of $K_0$~$K_7$ and $T_0$~$T_3$ keys. Further, System Codes are settable in 7 bits in combination of $K_0$~$K_6$ and CODE keys.



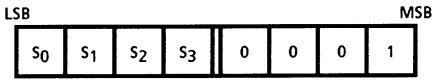

- $K_{08, 16, 24 \text{ and } 32}$ (the shift key) keys can be pushed simultaneously with other keys (the normal keys). However, the simultaneous keying of the shift keys and that of the normal keys are prohibited.
- The system code setting is made by the diode jumper between "CODE" lines and "$K_0$~$K_6$" lines. With diode jumper, data code will become "1".
  However, if the setting of "CODE" and "$K_0$~$K_6$" keys is only at one point, the keys are connectable directly without using the diode jumper.
  Further, "$S_7$" key is fixed at "1" and cannot be changed.

### 2. Data Format




Note 1: "80H~8FH" out of the system codes are free codes.

These codes are freely usable but they might have been used by other equipment and therefore, there is the possibility of occurrence of interference.




Other system codes have been customized and therefore, their general use is prohibited.

Toshiba will assume no responsibility for interference and other problems which may result from use of other system coded.

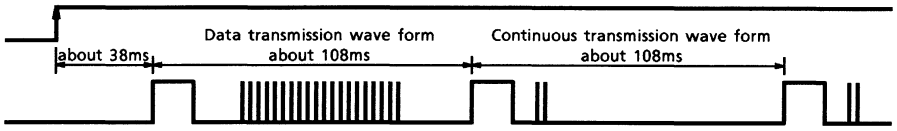
### 3. Key Data Code

| Key No. | Tn | Kn | $D_0$ | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ | $D_6$ | $D_7$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $K_{01}$ | $T_0$ | $K_0$ | 1 | 0 | 0 | 0 | 0 | • Shift key data<br>• "000" except dual keying. | | |
| $K_{02}$ | | $K_1$ | 0 | 1 | 0 | 0 | 0 | | | |
| $K_{03}$ | | $K_2$ | 1 | 1 | 0 | 0 | 0 | | | |
| $K_{04}$ | | $K_3$ | 0 | 0 | 1 | 0 | 0 | | | |
| $K_{05}$ | | $K_4$ | 1 | 0 | 1 | 0 | 0 | | | |
| $K_{06}$ | | $K_5$ | 0 | 1 | 1 | 0 | 0 | | | |
| $K_{07}$ | | $K_6$ | 1 | 1 | 1 | 0 | 0 | | | |
| $K_{08}$ | | $K_7$ | • Normal key data<br>• "00000" except dual keying. | | | | | 1 | 0 | 0 |
| $K_{09}$ | $T_1$ | $K_0$ | 1 | 0 | 0 | 1 | 0 | • Shift key data<br>• "000" except dual keying. | | |
| $K_{10}$ | | $K_1$ | 0 | 1 | 0 | 1 | 0 | | | |
| $K_{11}$ | | $K_2$ | 1 | 1 | 0 | 1 | 0 | | | |
| $K_{12}$ | | $K_3$ | 0 | 0 | 1 | 1 | 0 | | | |
| $K_{13}$ | | $K_4$ | 1 | 0 | 1 | 1 | 0 | | | |
| $K_{14}$ | | $K_5$ | 0 | 1 | 1 | 1 | 0 | | | |
| $K_{15}$ | | $K_6$ | 1 | 1 | 1 | 1 | 0 | | | |
| $K_{16}$ | | $K_7$ | • Normal key data<br>• "00000" except dual keying. | | | | | 1 | 1 | 0 |
| $K_{17}$ | $T_2$ | $K_0$ | 1 | 0 | 0 | 0 | 1 | • Shift key data<br>• "000" except dual keying. | | |
| $K_{18}$ | | $K_1$ | 0 | 1 | 0 | 0 | 1 | | | |
| $K_{19}$ | | $K_2$ | 1 | 1 | 0 | 0 | 1 | | | |
| $K_{20}$ | | $K_3$ | 0 | 0 | 1 | 0 | 1 | | | |
| $K_{21}$ | | $K_4$ | 1 | 0 | 1 | 0 | 1 | | | |
| $K_{22}$ | | $K_5$ | 0 | 1 | 1 | 0 | 1 | | | |
| $K_{23}$ | | $K_6$ | 1 | 1 | 1 | 0 | 1 | | | |
| $K_{24}$ | | $K_7$ | • Normal key data<br>• "00000" except dual keying. | | | | | 1 | 0 | 1 |
| $K_{25}$ | $T_3$ | $K_0$ | 1 | 0 | 0 | 1 | 1 | • Shift key data<br>• "000" except dual keying. | | |
| $K_{26}$ | | $K_1$ | 0 | 1 | 0 | 1 | 1 | | | |
| $K_{27}$ | | $K_2$ | 1 | 1 | 0 | 1 | 1 | | | |
| $K_{28}$ | | $K_3$ | 0 | 0 | 1 | 1 | 1 | | | |
| $K_{29}$ | | $K_4$ | 1 | 0 | 1 | 1 | 1 | | | |
| $K_{30}$ | | $K_5$ | 0 | 1 | 1 | 1 | 1 | | | |
| $K_{31}$ | | $K_6$ | 1 | 1 | 1 | 1 | 1 | | | |
| $K_{32}$ | | $K_7$ | • Normal key data<br>• "00000" except dual keying. | | | | | 1 | 1 | 1 |

- Normal key: $K_{01}$~$K_{07}$, $K_{09}$~$K_{15}$, $K_{17}$~$K_{23}$, $K_{25}$~$K_{31}$
- Shift key: $K_{08}$, $K_{16}$, $K_{24}$, $K_{32}$

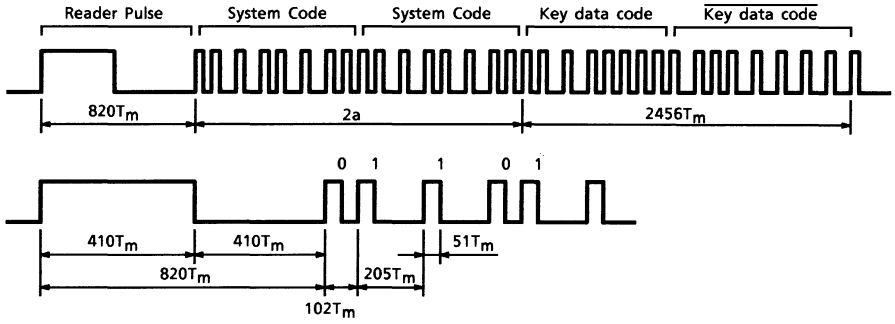
## 4. $TX_{OUT}$ Output Wave Form

### Key ON

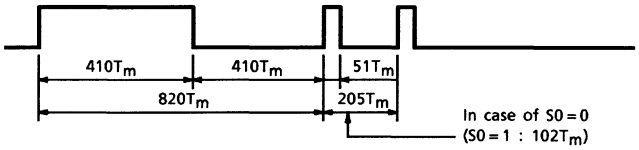



Note 2: In case of $f_{OSC}$ = 455 kHz

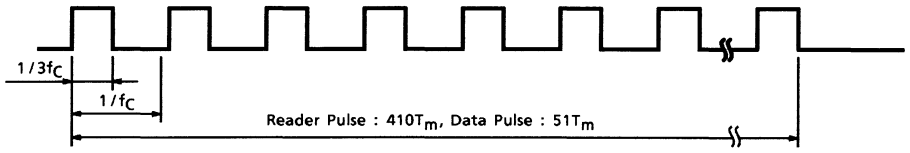
### Data Transmission Wave Form




### Continuous Transmission Wave Form




### Carrier Wave Form




$T_m = 5/f_{OSC}$: System clock

a: System code output time

$f_C = f_{OSC}/12$

When oscillation frequency is 455 kHz, signal is output after pulse modulated by 37.9 kHz of duty 1/3, which is a 1/12 division by the carrier generation circuit.

## Caution

In preparing a receiving software, strictly follow the following instructions:

- In case of system codes, the same code is transmitted twice and therefore, always decode these 2 codes and judge if they agree with each other.
- In case of key data codes, always decode a key data code and its reversed code and judge if they agree with each other.

## Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{DD}$ | −0.3~5.0 | V |
| Input voltage | $V_{IN}$ | VSS − 0.3~$V_{DD}$ + 0.3 | V |
| Output current | $I_{OUT}$ | −20 | mA |
| Power dissipation | $P_D$ | 350 (300) (Note 3) | mW |
| Operating temperature | $T_{opr}$ | −20~75 | °C |
| Storage temperature | $T_{stg}$ | −40~125 | °C |

Note 3: The value shown in parentheses applies to the TC9243F.

## Electrical Characteristics

### Recommended Operating Conditions

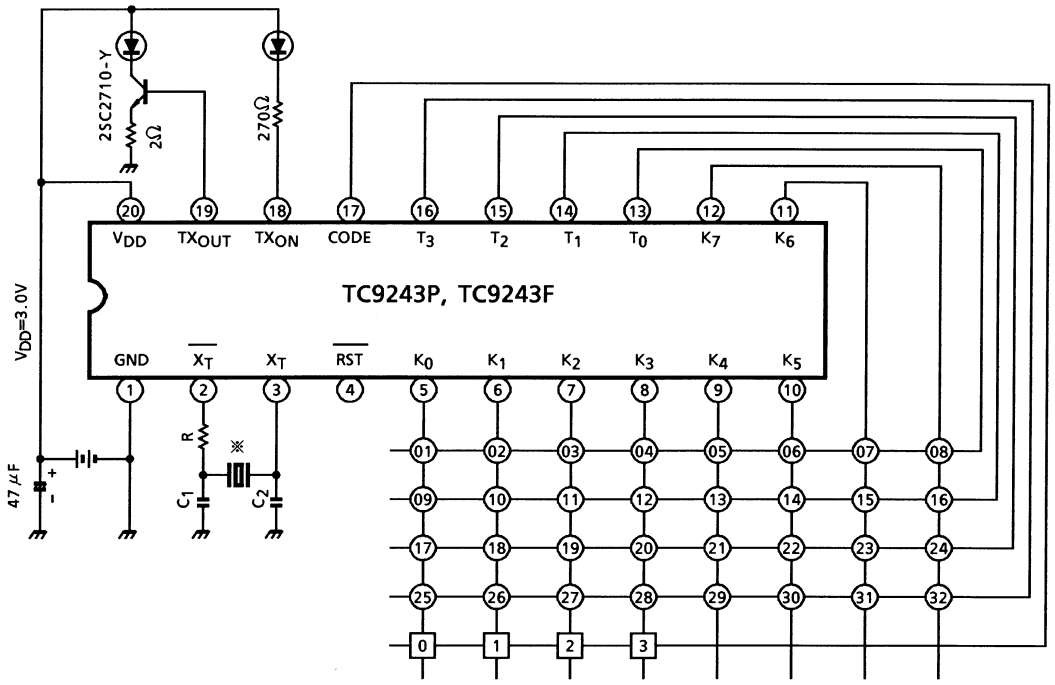
**(unless otherwise specified, $V_{DD}$ = 3.0 V, Ta = 25°C, for items with an asterisk *, Ta = −25~75°C)**

| Characteristics | | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Operating supply voltage * | | $V_{DD}$ | — | — | 2.0 | — | 4.0 | V |
| Oscillation frequency * | | $f_{OSC}$ | — | — | 400 | — | 800 | kHz |
| Input voltage | "H" level | $V_{IH1}$ | — | (except $\overline{RST}$) | $V_{DD}$ × 0.7 | — | $V_{DD}$ | V |
| | "L" level | $V_{IL1}$ | — | (except $\overline{RST}$) | 0 | — | $V_{DD}$ × 0.3 | |
| Input voltage | "H" level | $V_{IH2}$ | — | ($\overline{RST}$) | $V_{DD}$ × 0.8 | — | $V_{DD}$ | V |
| | "L" level | $V_{IL2}$ | — | ($\overline{RST}$) | 0 | — | $V_{DD}$ × 0.2 | |

### DC Characteristics (unless otherwise specified, $V_{DD}$ = 3.0 V, Ta = 25°C)

| Characteristics | | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Operating supply current | | $I_{DD}$ | — | $f_{OSC}$ = 455 kHz | — | — | 1.0 | MA |
| Static supply current | | $I_{QD}$ | — | At time of "Hold" | — | — | 1.0 | μA |
| Pull-down resistor | | $R_D$ | — | ($K_0$~$K_7$) | 100 | — | 400 | kΩ |
| Pull-up resistor | | $R_U$ | — | ($\overline{RST}$) | 25 | — | 100 | kΩ |
| Output current | "H" level | $I_{OH}$ | — | ($TX_{OUT}$) $V_{OH}$ = 1.5 V | −10 | — | — | mA |
| | "L" level | $I_{OL}$ | — | ($TX_{ON}$) $V_{OL}$ = 1.5 V | 5 | — | — | |
| Input leak current | | $I_{LI}$ | — | $V_{IN}$ = $V_{DD}$, $V_{SS}$ | −1.0 | — | 1.0 | μA |

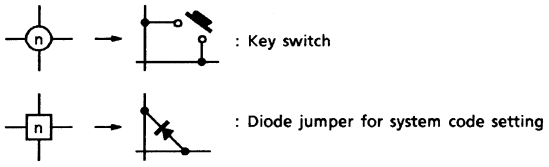
## Application Circuit




Note 4: Ceramic oscillator CSB455E (Murata Seisakusho) $C_1 = C_2 = 100$ pF R = 6.8 kΩ

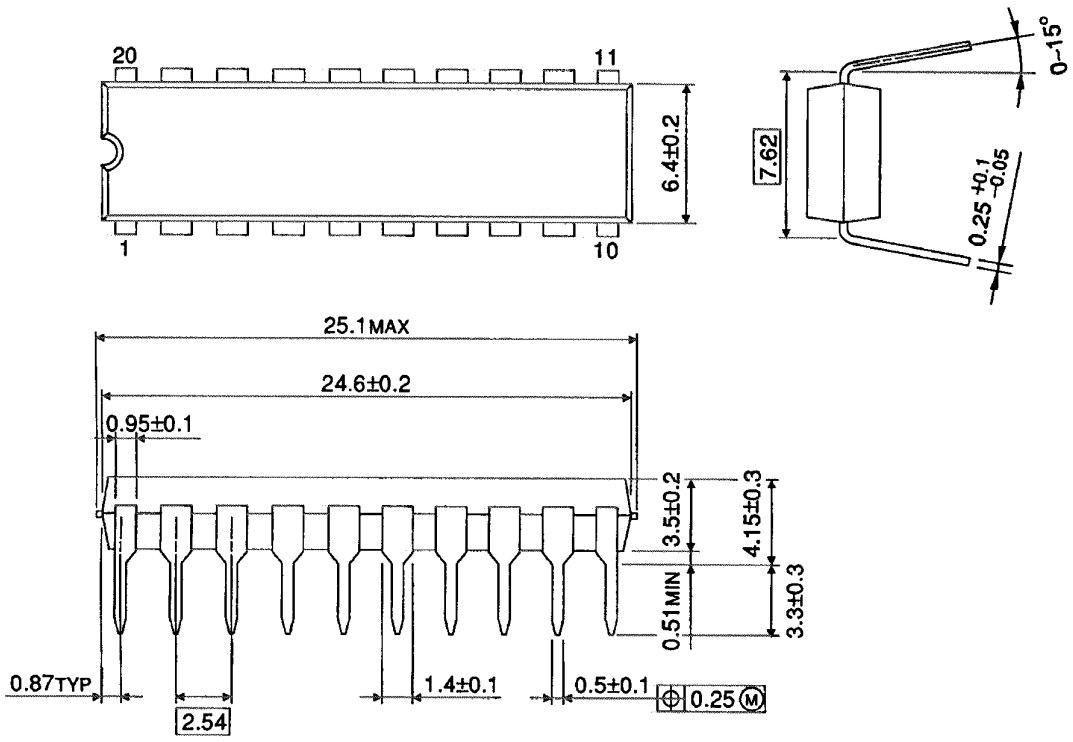
FCR455K3 (TDK) $C_1 = C_2 = 220$ pF R = 2.2 kΩ

or equivalent



## Package Dimensions

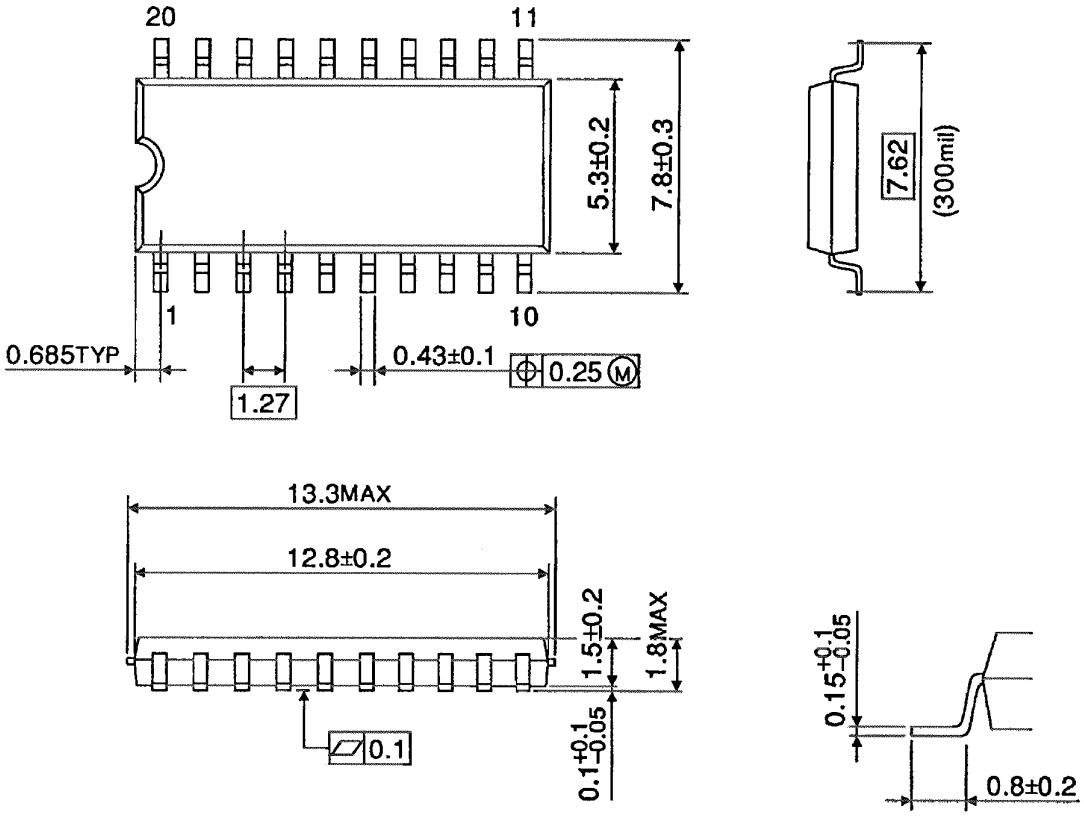
DIP20-P-300-2.54A Unit : mm




Weight: 1.4g (typ.)

## Package Dimensions

SOP20-P-300-1.27 Unit : mm




Weight: 0.48 g (typ.)

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