**TC7W53FK : UNDER DEVELOPMENT**

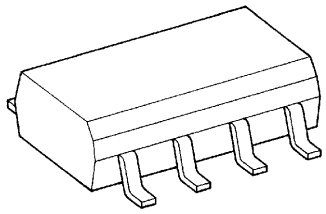
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7W53F, TC7W53FU, TC7W53FK

## 2-CHANNEL MULTIPLEXER / DEMULTIPLEXER

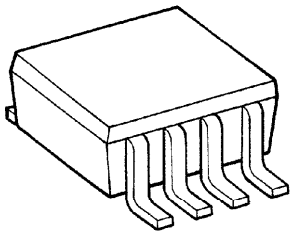
The TC7W53 is a high speed CMOS ANALOG MULTIPLEXER / DEMULTIPLEXER fabricated with silicon gate CMOS technology.
They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
The TC7W53 has a 2 channel configuration.
The digital signal to the control terminal turns "ON" the corresponding switch of each channel a large amplitude signal ($V_{CC}$-$V_{EE}$) can then be switched by the small logical amplitude ($V_{CC}$-GND) control signal.
For example, in the case of $V_{CC}$ = 5V, GND = 0V, $V_{EE}$ = 5V, signals between −5V and +5V can be switched from the logical circuit with a single power supply of 5V. As the ON-resistance of each switch is low, they can be connected to circuit with low input impedance.
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

TC7W53F



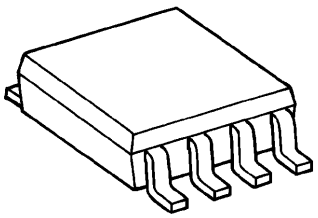
SOP8-P-1.27

TC7W53FU



SSOP8-P-0.65

TC7W53FK



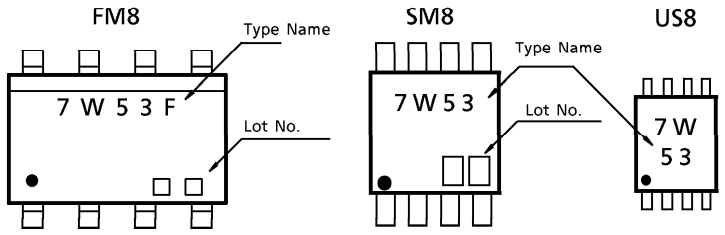
SSOP8-P-0.50A

Weight
SOP8-P-1.27 : 0.05g (Typ.)
SSOP8-P-0.65 : 0.02g (Typ.)
SSOP8-P-0.50A : 0.01g (Typ.)

### FEATURES

- High Speed ····· $t_{pd}$ = 15ns (Typ.) at $V_{CC}$ = 5V, $V_{EE}$ = 0V
- Low Power Dissipation ····· $I_{CC}$ = 4$\mu$A (Max.) at Ta = 25°C
- High Noise Immunity ····· $V_{NIH} = V_{NIL}$ = 28% $V_{CC}$ (Min.)
- Low ON Resistance ····· $R_{ON}$ = 50Ω (Typ.) at $V_{CC}$-$V_{EE}$ = 9V
- High Degree of Linearity ····· THD = 0.02 (Typ.) at $V_{CC}$-$V_{EE}$ = 9V
- Pin and Function Compatible with TC4W53

### MARKING




980910EBA2

**MAXIMUM RATINGS** (Ta = 25°C)

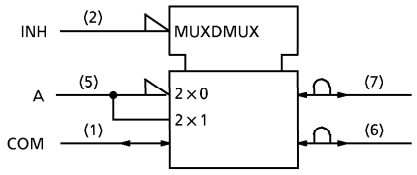
| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage Range | $V_{CC}$ | −0.5~7 | V |
| | $V_{CC}$~$V_{EE}$ | −0.5~13 | |
| Control Input Voltage | $V_{IN}$ | −0.5~$V_{CC}$+0.5 | V |
| Switch I/O Voltage | $V_{I/O}$ | $V_{EE}$−0.5~$V_{CC}$+0.5 | V |
| Control Input Diode Current | $I_{CK}$ | ±20 | mA |
| I/O Diode Current | $I_{IOK}$ | ±20 | mA |
| Switch Through Current | $I_T$ | ±25 | mA |
| DC $V_{CC}$/GND Current | $I_{CC}$ | ±25 | mA |
| Power Dissipation | $P_D$ | 300 (FM8, SM8) | mW |
| | | 200 (US8) | |
| Storage Temperature | $T_{stg}$ | −65~150 | °C |
| Lead Temperature (10 s) | $T_L$ | 260 | °C |

**TRUTH TABLE**

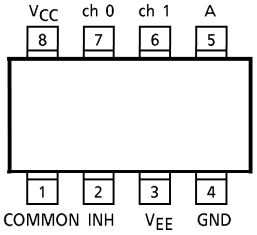
| CONTROL INPUT | | ON CHANNEL |
|---|---|---|
| INH | A | |
| L | L | ch 0 |
| L | H | ch 1 |
| H | × | NONE |

× : Don't care

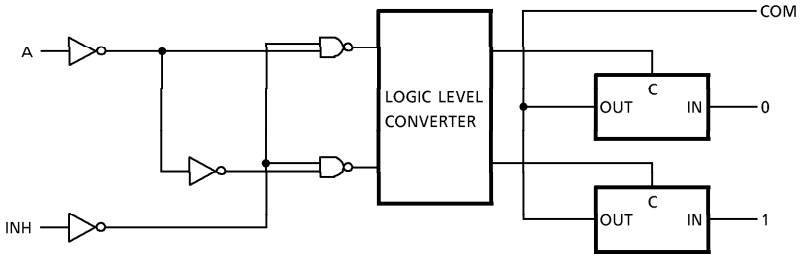
**LOGIC SYMBOL**




**PIN ASSIGNMENT** (TOP VIEW)




**LOGIC DIAGRAM**



**RECOMMENDED OPERATING CONDITIONS**

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 2~12 | V |
| | $V_{EE}$ | −6~0 | V |
| | $V_{CC}$~$V_{EE}$ | 2~12 | V |
| Control Input Voltage | $V_{IN}$ | 0~$V_{CC}$ | V |
| Switch I/O Voltage | $V_{I/O}$ | 0~$V_{CC}$ | V |
| Operating Temperature | $T_{opr}$ | −40~85 | °C |
| Input Rise and Fall Time | $t_r$, $t_f$ | 0~1000 ($V_{CC}$ = 2.0V) | ns |
| | | 0~500 ($V_{CC}$ = 4.5V) | |
| | | 0~400 ($V_{CC}$ = 6.0V) | |

**DC ELECTRICAL CHARACTERISTICS**

| CHARACTERISTIC | SYMBOL | | $V_{EE}$ (V) | $V_{CC}$ (V) | Ta = 25°C MIN. | Ta = 25°C TYP. | Ta = 25°C MAX. | Ta = −40~85°C MIN. | Ta = −40~85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| High-Level Control Input Voltage | $V_{IHC}$ | | | 2.0 | 1.5 | — | — | 1.5 | — | V |
| | | | | 4.5 | 3.15 | — | — | 3.15 | — | |
| | | | | 6.0 | 4.2 | — | — | 4.2 | — | |
| Low-Level Control Input Voltage | $V_{ILC}$ | | | 2.0 | — | — | 0.5 | — | 0.5 | V |
| | | | | 4.5 | — | — | 1.35 | — | 1.35 | |
| | | | | 6.0 | — | — | 1.8 | — | 1.8 | |
| ON Resistance | $R_{ON}$ | $V_{IN}$ = $V_{IHC}$, $V_{I/O}$ = $V_{CC}$ to GND, $V_{I/O} \leqq$ 2mA | GND | 4.5 | — | 85 | 180 | — | 225 | Ω |
| | | | −4.5 | 4.5 | — | 55 | 120 | — | 150 | |
| | | | −6.0 | 6.0 | — | 50 | 100 | — | 125 | |
| | | $V_{IN}$ = $V_{IHC}$, $V_{I/O}$ = $V_{CC}$ or GND, $V_{I/O} \leqq$ 2mA | GND | 2.0 | — | 150 | — | — | — | |
| | | | GND | 4.5 | — | 70 | 150 | — | 190 | |
| | | | −4.5 | 4.5 | — | 50 | 100 | — | 125 | |
| | | | −6.0 | 6.0 | | 45 | 80 | — | 100 | |
| Difference of ON Resistance Between Switches | $\Delta R_{ON}$ | $V_{IN}$ = $V_{IHC}$, $V_{I/O}$ = $V_{CC}$ to GND, $V_{I/O} \leqq$ 2mA | GND | 4.5 | — | 10 | 30 | — | 35 | Ω |
| | | | −4.5 | 4.5 | — | 5 | 12 | — | 15 | |
| | | | −6.0 | 6.0 | — | 5 | 10 | — | 12 | |
| Input/Output Leakage Current (SWITCH OFF) | $I_{OFF}$ | $V_{OS}$ = GND, $V_{IS}$ = GND to $V_{CC}$, $V_{IN}$ = $V_{ILC}$ or $V_{IHC}$ | GND | 6.0 | — | — | ±60 | — | ±600 | nA |
| | | | −6.0 | 6.0 | | | ±100 | — | ±1000 | |
| Switch Input Leakage Current (SWITCH ON OUTPUT OPEN) | $I_{IZ}$ | $V_{OS}$ = $V_{CC}$ or GND, $V_{IN}$ = $V_{ILC}$ or $V_{IHC}$ | GND | 6.0 | — | — | ±60 | — | ±600 | nA |
| | | | −6.0 | 6.0 | | | ±100 | — | ±1000 | |
| Control Input Current | $I_{IN}$ | $V_{IN}$ = $V_{CC}$ or GND | GND | 6.0 | — | — | ±0.1 | — | ±1.0 | μA |
| Quiescent Supply Current | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | GND | 6.0 | — | — | 4 | — | 40 | μA |
| | | | −6.0 | 6.0 | — | — | 8 | — | 80 | |

**AC ELECTRICAL CHARACTERISTICS** ($C_L$ = 50pF, Input $t_r = t_f$ = 6ns, GND = 0V)

| CHARACTERISTIC | | TEST CONDITION | $V_{EE}$ (V) | $V_{CC}$ (V) | Ta = 25°C MIN. | Ta = 25°C TYP. | Ta = 25°C MAX. | Ta = −40~85°C MIN. | Ta = −40~85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| Phase Difference Between Input and Output | $\phi$I / O | | GND | 2.0 | — | 25 | 60 | — | 75 | ns |
| | | | GND | 4.5 | — | 6 | 12 | — | 15 | |
| | | | GND | 6.0 | — | 5 | 10 | — | 13 | |
| | | | −4.5 | 4.5 | — | 4 | — | — | — | |
| Output Enable Time | $t_{pZL}$ $t_{pZH}$ | $R_L$ = 1kΩ | GND | 2.0 | — | 50 | 225 | — | 280 | ns |
| | | | GND | 4.5 | — | 14 | 45 | — | 56 | |
| | | | GND | 6.0 | — | 12 | 38 | — | 48 | |
| | | | −4.5 | 4.5 | — | 14 | — | — | — | |
| Output Disable Time | $t_{pLZ}$ $t_{pHZ}$ | $R_L$ = 1kΩ | GND | 2.0 | — | 95 | 225 | — | 280 | ns |
| | | | GND | 4.5 | — | 30 | 45 | — | 56 | |
| | | | GND | 6.0 | — | 26 | 38 | — | 48 | |
| | | | −4.5 | 4.5 | — | 26 | — | — | — | |
| Control Input Capacitance | $C_{IN}$ | | — | — | — | 5 | 10 | — | 10 | pF |
| Common Terminal Capacitance | $C_{IS}$ | | −5.0 | 5.0 | — | 11 | 20 | — | 20 | pF |
| Switch Terminal Capacitance | $C_{OS}$ | | −5.0 | 5.0 | — | 7 | 15 | — | 15 | pF |
| Feed Through Capacitance | $C_{IOS}$ | | −5.0 | 5.0 | — | 0.75 | 2 | — | 2 | pF |
| Power Dissipation Capacitance | $C_{PD}$ | (Note 1) | GND | 5.0 | — | 67 | — | — | — | pF |

(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 :

$$I_{CC\,(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2$$

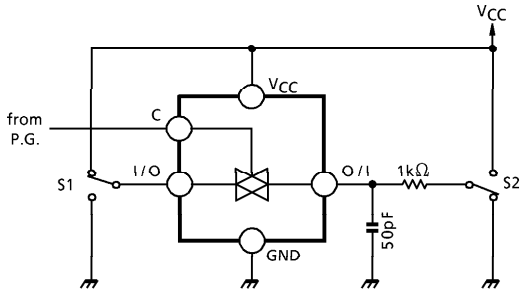
**ANALOG SWITCH CHARACTERISTICS** (GND = 0V, Ta = 25°C)

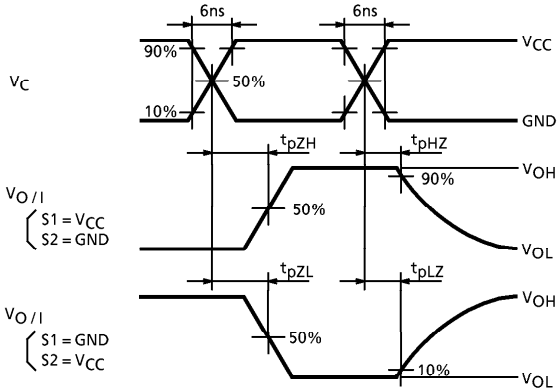
| CHARACTERISTIC | | TEST CONDITION | | $V_{EE}$ (V) | $V_{CC}$ (V) | TYP. | UNIT |
|---|---|---|---|---|---|---|---|
| Sine Wave Distortion (T.H.D) | | $R_L = 10k\Omega$, $C_L = 50pF$, $f_{IN} = 1kHz$ | $V_{IN} = 4.0V_{p-p}$ | − 2.25 | 2.25 | 0.025 | % |
| | | | $V_{IN} = 8.0V_{p-p}$ | − 4.5 | 4.5 | 0.02 | |
| | | | $V_{IN} = 1.1V_{p-p}$ | − 6.0 | 6.0 | 0.018 | |
| Frequency Response (Switch ON) | $f_{MAX}$ | Adjust $f_{IN}$ voltage to obtain 0dBm at $V_{OS}$ Increase $f_{IN}$ until dB Meter reads − 3dB, $R_L = 50\Omega$, $C_L = 10pF$, $f_{IN} = 1MHz$, Sine Wave | *1 | − 2.25 | 2.25 | 120 | MHz |
| | | | *2 | | | 95 | |
| | | | *1 | − 4.5 | 4.5 | 190 | |
| | | | *2 | | | 150 | |
| | | | *1 | − 6.0 | 6.0 | 200 | |
| | | | *2 | | | 190 | |
| Feedthrough Attenuation (Switch OFF) | | Vin is centered at $(V_{CC}-V_{EE})/2$, Adjust input for 0dBm, $R_L = 600\Omega$, $C_L = 50pF$, $f_{IN} = 1MHz$, Sine Wave | | − 2.25 | 2.25 | − 50 | dB |
| | | | | − 4.5 | 4.5 | − 50 | |
| | | | | − 6.0 | 6.0 | − 50 | |
| Crosstalk (Control Input to Signal Output) | | $R_L = 600\Omega$, $C_L = 50pF$, $f_{IN} = 1MHz$, Square Wave ($t_r = t_f = 6ns$) | | − 2.25 | 2.25 | 60 | mV |
| | | | | − 4.5 | 4.5 | 140 | |
| | | | | − 6.0 | 6.0 | 200 | |
| Crosstalk (Between any switches) | | Adjust $V_{IN}$ to obtain 0dBm at Input, $R_L = 600\Omega$, $C_L = 50pF$, $f_{IN} = 1MHz$, Sine Wave | | − 2.25 | 2.25 | − 50 | dB |
| | | | | − 4.5 | 4.5 | − 50 | |
| | | | | − 6.0 | 6.0 | − 50 | |

*1 : Input COMMON Terminal, and measured at SWITCH Terminal.
*2 : Input SWITCH Terminal, and measured at COMMON Terminal.
(Note): These characteristics are determined by design of device.

## SWITCHING CHARACTERISTICS TEST CIRCUITS

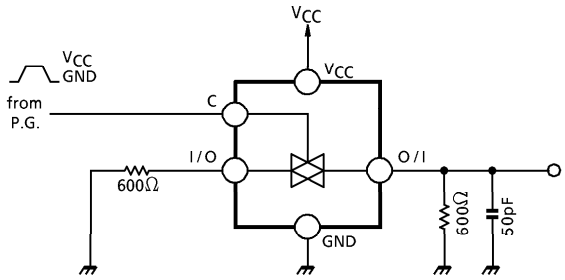
1. $t_{pLZ}$, $t_{pHZ}$, $t_{pZL}$, $t_{pZH}$



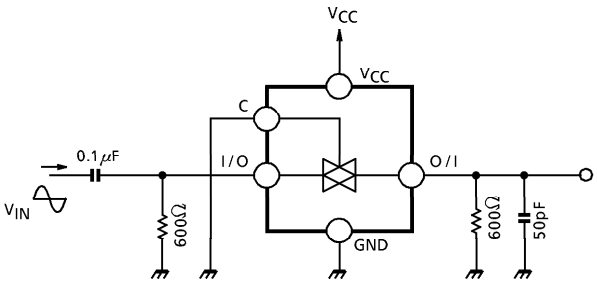




2. CROSS TALK (CONTROL INPUT-SWITCH OUTPUT)

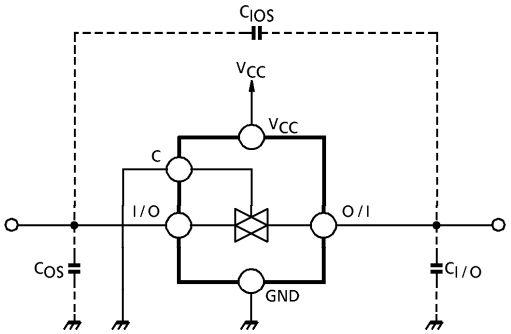
fin = 1MHz, duty = 50%, $t_r = t_f = 6ns$



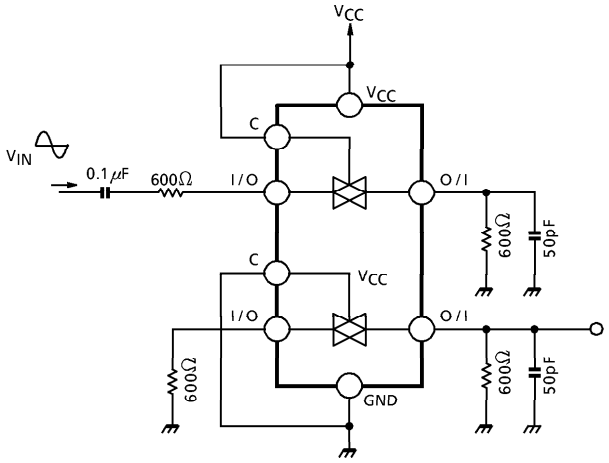

3. FEEDTHROUGH ATTENUATION



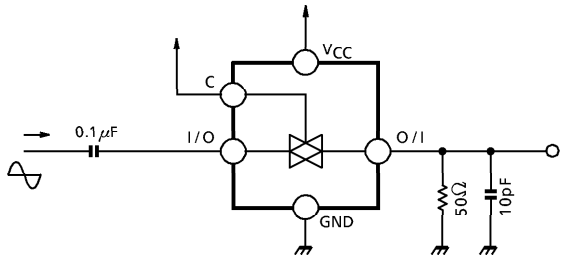
4. Clos, $C_{I/O}$




5. CROSS TALK (BETWEEN ANY TWO SWITCHES)



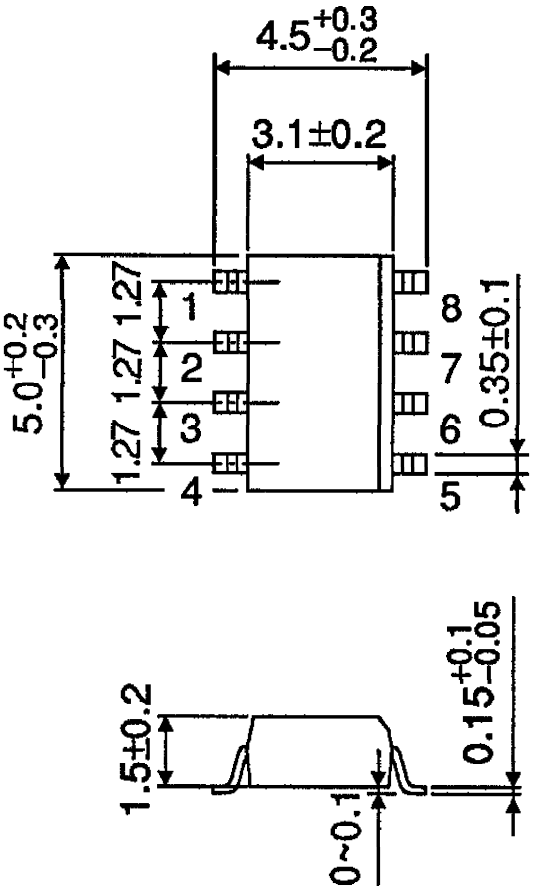

6. FREQUENCY RESPONSE (SWITCH ON)



**OUTLINE DRAWING**

SOP8-P-1.27

Unit : mm

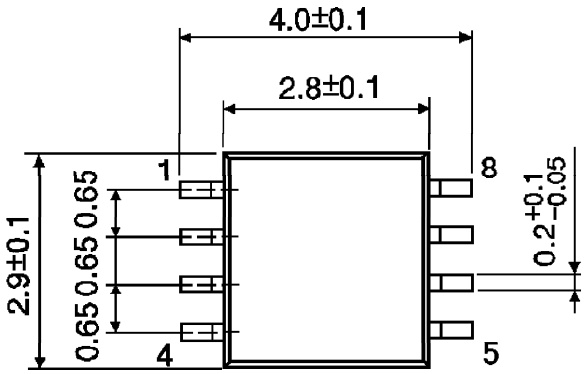


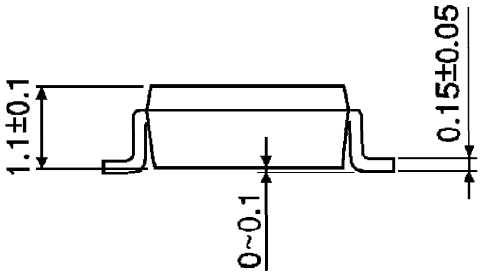

Weight : 0.05g (Typ.)

**OUTLINE DRAWING**

SSOP8-P-0.65

Unit : mm



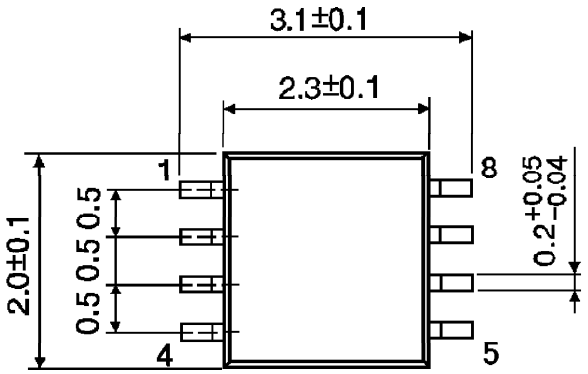



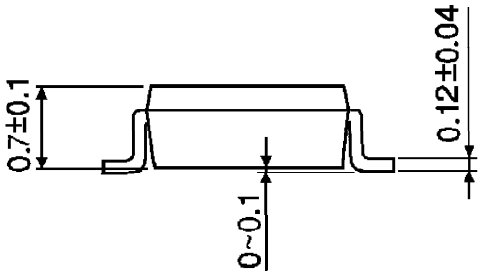

Weight : 0.02g (Typ.)

**OUTLINE DRAWING**

SSOP8-P-0.50A

Unit : mm




Weight : 0.01g (Typ.)