

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.

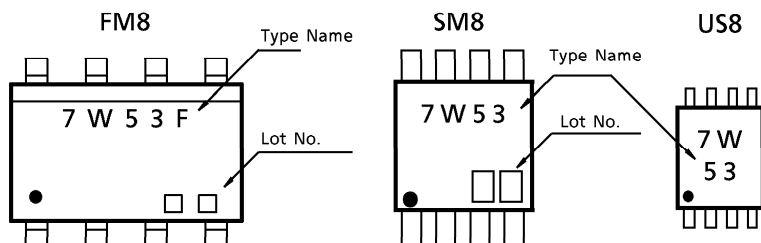
For example, in the case of  $V_{CC}=5V$ ,  $GND=0V$ ,  $V_{EE}=5V$ , signals between  $-5V$  and  $+5V$  can be switched from the logical circuit with a single power supply of 5V. As the ON-resistance of each switch is low, they can be connected to circuit with low input impedance.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

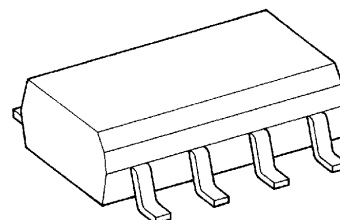
### FEATURES

- High Speed .....  $t_{pd} = 15ns$  (Typ.)  
at  $V_{CC} = 5V$ ,  $V_{EE} = 0V$
- Low Power Dissipation .....  $I_{CC} = 4\mu A$  (Max.) at  $T_a = 25^\circ C$
- High Noise Immunity .....  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Low ON Resistance .....  $R_{ON} = 50\Omega$  (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

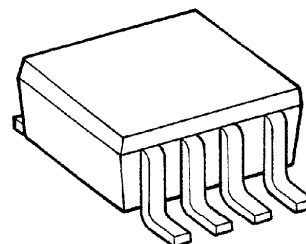


TC7W53F



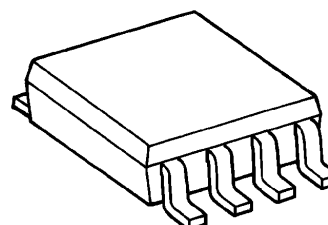
SOP8-P-1.27

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.) |

980910EBA2

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MAXIMUM RATINGS (Ta = 25°C)

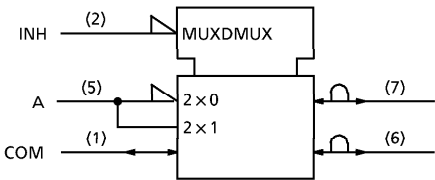
| CHARACTERISTIC              | SYMBOL  | RATING              | UNIT |
|-----------------------------|---------|---------------------|------|
| Supply Voltage Range        | VCC     | - 0.5~7             | V    |
|                             | VCC~VEE | - 0.5~13            |      |
| Control Input Voltage       | VIN     | - 0.5~VCC + 0.5     | V    |
| Switch I/O Voltage          | VI/O    | VEE - 0.5~VCC + 0.5 | V    |
| Control Input Diode Current | ICK     | ± 20                | mA   |
| I/O Diode Current           | IIOK    | ± 20                | mA   |
| Switch Through Current      | IT      | ± 25                | mA   |
| DC VCC/GND Current          | ICC     | ± 25                | mA   |
| Power Dissipation           | PD      | 300 (FM8, SM8)      | mW   |
|                             |         | 200 (US8)           |      |
| Storage Temperature         | Tstg    | - 65~150            | °C   |
| Lead Temperature (10 s)     | TL      | 260                 | °C   |

TRUTH TABLE

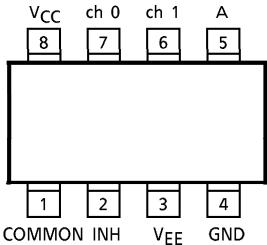
| CONTROL INPUT |   | ON CHANNEL |
|---------------|---|------------|
| INH           | A |            |
| L             | L | ch 0       |
| L             | H | ch 1       |
| H             | x | NONE       |

x : Don't care

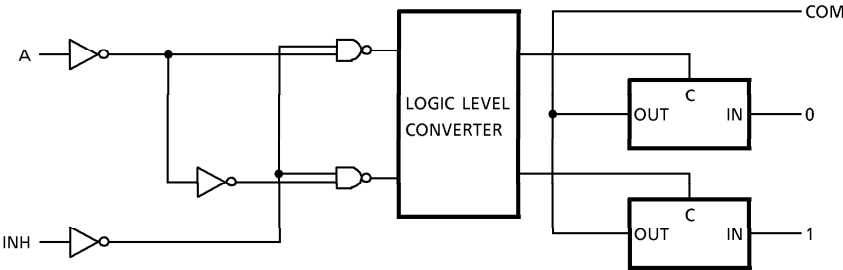
LOGIC SYMBOL



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    |
|                          | $V_{CC} \sim V_{EE}$ | 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          |                                                                                 | $V_{EE}$<br>(V) | $V_{CC}$<br>(V) | Ta = 25°C |      |           | Ta = -40~85°C |            | UNIT     |
|------------------------------------------------------|-----------------|---------------------------------------------------------------------------------|-----------------|-----------------|-----------|------|-----------|---------------|------------|----------|
|                                                      |                 |                                                                                 |                 |                 | MIN.      | TYP. | MAX.      | MIN.          | MAX.       |          |
| 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                                        | $R_{ON}$        | $V_{IN} = V_{IHC}$<br>$V_{I/O} = V_{CC}$ to GND<br>$V_{I/O} \leq 2mA$           | GND             | 4.5             | —         | 85   | 180       | —             | 225        | $\Omega$ |
|                                                      |                 |                                                                                 | -4.5            | 4.5             | —         | 55   | 120       | —             | 150        |          |
|                                                      |                 |                                                                                 | -6.0            | 6.0             | —         | 50   | 100       | —             | 125        |          |
|                                                      |                 | $V_{IN} = V_{IHC}$<br>$V_{I/O} = V_{CC}$ or GND<br>$V_{I/O} \leq 2mA$           | GND             | 2.0             | —         | 150  | —         | —             | —          |          |
|                                                      |                 |                                                                                 | GND             | 4.5             | —         | 70   | 150       | —             | 190        |          |
|                                                      |                 |                                                                                 | -4.5            | 4.5             | —         | 50   | 100       | —             | 125        |          |
| Difference of ON Resistance Between Switches         | $\Delta R_{ON}$ | $V_{IN} = V_{IHC}$<br>$V_{I/O} = V_{CC}$ to GND<br>$V_{I/O} \leq 2mA$           | -6.0            | 6.0             | —         | 45   | 80        | —             | 100        | $\Omega$ |
|                                                      |                 |                                                                                 | GND             | 4.5             | —         | 10   | 30        | —             | 35         |          |
|                                                      |                 |                                                                                 | -4.5            | 4.5             | —         | 5    | 12        | —             | 15         |          |
| Input/Output Leakage Current (SWITCH OFF)            | $I_{OFF}$       | $V_{OS} = GND$<br>$V_{IS} = GND$ to $V_{CC}$<br>$V_{IN} = V_{ILC}$ or $V_{IHC}$ | GND             | 6.0             | —         | —    | $\pm 60$  | —             | $\pm 600$  | nA       |
|                                                      |                 |                                                                                 | -6.0            | 6.0             | —         | —    | $\pm 100$ | —             | $\pm 1000$ |          |
| Switch Input Leakage Current (SWITCH ON OUTPUT OPEN) | $I_{IZ}$        | $V_{OS} = V_{CC}$ or GND<br>$V_{IN} = V_{ILC}$ or $V_{IHC}$                     | GND             | 6.0             | —         | —    | $\pm 60$  | —             | $\pm 600$  | nA       |
|                                                      |                 |                                                                                 | -6.0            | 6.0             | —         | —    | $\pm 100$ | —             | $\pm 1000$ |          |
| Control Input Current                                | $I_{IN}$        | $V_{IN} = V_{CC}$ or GND                                                        | GND             | 6.0             | —         | —    | $\pm 0.1$ | —             | $\pm 1.0$  | $\mu A$  |
| Quiescent Supply Current                             | $I_{CC}$        | $V_{IN} = V_{CC}$ or GND                                                        | GND             | 6.0             | —         | —    | 4         | —             | 40         | $\mu A$  |
|                                                      |                 |                                                                                 | -6.0            | 6.0             | —         | —    | 8         | —             | 80         |          |

AC ELECTRICAL CHARACTERISTICS ( $C_L = 50\text{pF}$ , Input  $t_r = t_f = 6\text{ns}$ , GND = 0V)

| CHARACTERISTIC                                  |                        | TEST CONDITION          | V <sub>EE</sub><br>(V) | V <sub>CC</sub><br>(V) | Ta = 25°C |      |      | Ta = -40~85°C |      | UNIT |
|-------------------------------------------------|------------------------|-------------------------|------------------------|------------------------|-----------|------|------|---------------|------|------|
|                                                 |                        |                         |                        |                        | MIN.      | TYP. | MAX. | MIN.          | MAX. |      |
| Phase Difference<br>Between Input and<br>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<br>Time                           | $t_{pZL}$<br>$t_{pZH}$ | $R_L = 1\text{k}\Omega$ | 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                             | $t_{pLZ}$<br>$t_{pHZ}$ | $R_L = 1\text{k}\Omega$ | 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<br>Capacitance                    | $C_{IN}$               |                         | —                      | —                      | —         | 5    | 10   | —             | 10   | pF   |
| Common Terminal<br>Capacitance                  | $C_{IS}$               |                         | -5.0                   | 5.0                    | —         | 11   | 20   | —             | 20   | pF   |
| Switch Terminal<br>Capacitance                  | $C_{OS}$               |                         | -5.0                   | 5.0                    | —         | 7    | 15   | —             | 15   | pF   |
| Feed Through<br>Capacitance                     | $C_{IOS}$              |                         | -5.0                   | 5.0                    | —         | 0.75 | 2    | —             | 2    | pF   |
| Power Dissipation<br>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 :

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

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

| CHARACTERISTIC                             |                                       | TEST CONDITION                                                                                                                                                                                           |                                       | V <sub>EE</sub><br>(V) | V <sub>CC</sub><br>(V) | TYP.  | UNIT |
|--------------------------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------|------------------------|-------|------|
| Sine Wave Distortion (T.H.D)               |                                       | R <sub>L</sub> = 10kΩ, C <sub>L</sub> = 50pF<br>f <sub>IN</sub> = 1kHz                                                                                                                                   | V <sub>IN</sub> = 4.0V <sub>p-p</sub> | - 2.25                 | 2.25                   | 0.025 | %    |
|                                            | V <sub>IN</sub> = 8.0V <sub>p-p</sub> |                                                                                                                                                                                                          | - 4.5                                 | 4.5                    | 0.02                   |       |      |
|                                            | V <sub>IN</sub> = 1.1V <sub>p-p</sub> |                                                                                                                                                                                                          | - 6.0                                 | 6.0                    | 0.018                  |       |      |
| Frequency Response (Switch ON)             | f <sub>MAX</sub>                      | Adjust f <sub>IN</sub> voltage to obtain 0dBm at V <sub>OS</sub> Increase f <sub>IN</sub> until dB Meter reads - 3dB<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF<br>f <sub>IN</sub> = 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 <sub>CC</sub> -V <sub>EE</sub> ) / 2<br>Adjust input for 0dBm<br>R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF<br>f <sub>IN</sub> = 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 <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF<br>f <sub>IN</sub> = 1MHz, Square Wave (t <sub>r</sub> = t <sub>f</sub> = 6ns)                                                                              | - 2.25                                | 2.25                   | 60                     | mV    |      |
|                                            | - 4.5                                 | 4.5                                                                                                                                                                                                      | 140                                   |                        |                        |       |      |
|                                            | - 6.0                                 | 6.0                                                                                                                                                                                                      | 200                                   |                        |                        |       |      |
| Crosstalk (Between any switches)           |                                       | Adjust V <sub>IN</sub> to obtain 0dBm at Input<br>R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF<br>f <sub>IN</sub> = 1MHz, Sine Wave                                                                      | - 2.25                                | 2.25                   | - 50                   | dB    |      |
|                                            | - 4.5                                 | 4.5                                                                                                                                                                                                      | - 50                                  |                        |                        |       |      |
|                                            | - 6.0                                 | 6.0                                                                                                                                                                                                      | - 50                                  |                        |                        |       |      |

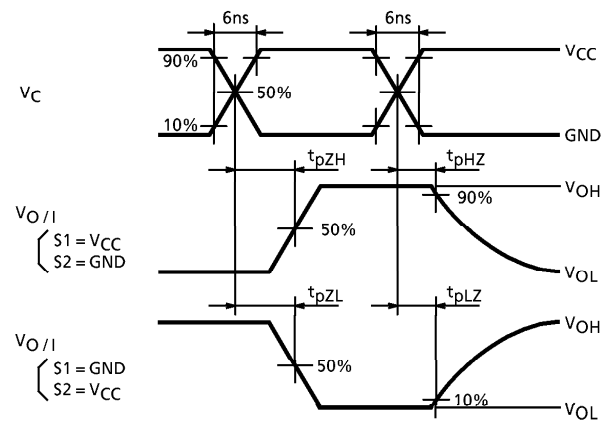
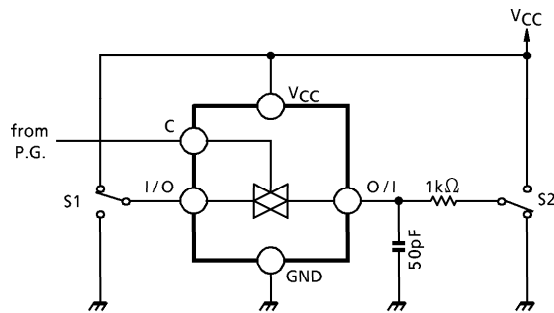
\*1 : Input COMMON Terminal, and measured at SWITCH Terminal.

\*2 : Input SWITCH Terminal, and measured at COMMON Terminal.

(Note): These characteristics are determined by design of device.

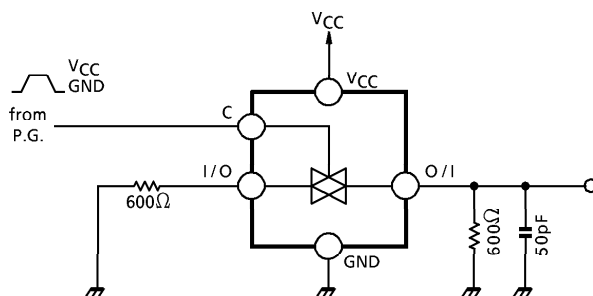
# SWITCHING CHARACTERISTICS TEST CIRCUITS

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

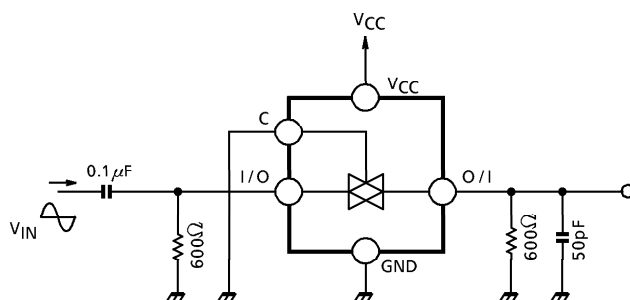


## 2. CROSS TALK (CONTROL INPUT-SWITCH OUTPUT)

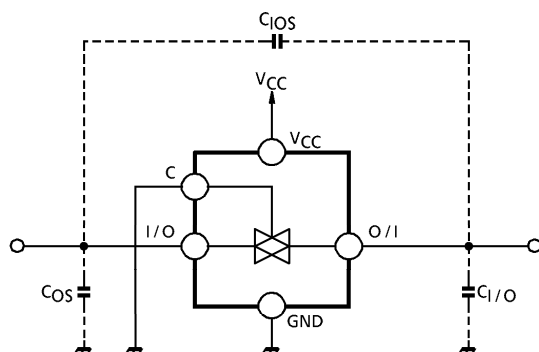
$f_{in} = 1\text{MHz}$ , duty = 50%,  $t_r = t_f = 6\text{ns}$



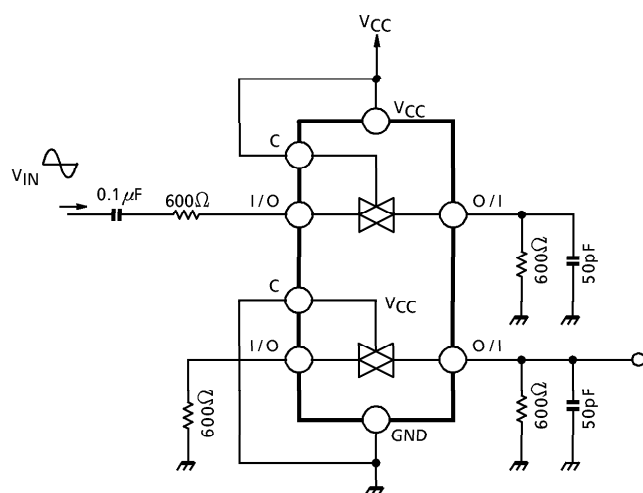
## 3. FEEDTHROUGH ATTENUATION



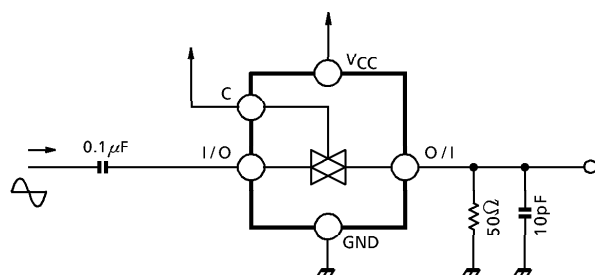
4. Clos,  $C_{I/O}$



5. CROSS TALK (BETWEEN ANY TWO SWITCHES)

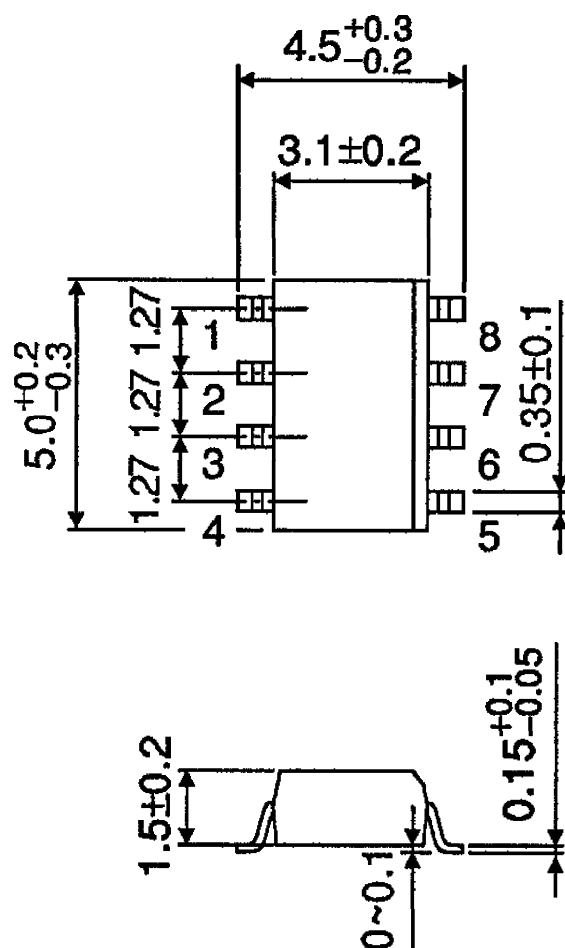


6. FREQUENCY RESPONSE (SWITCH ON)



OUTLINE DRAWING  
SOP8-P-1.27

Unit : mm

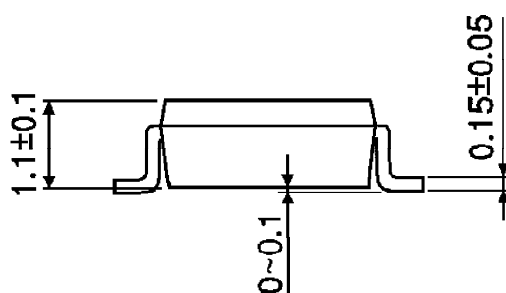
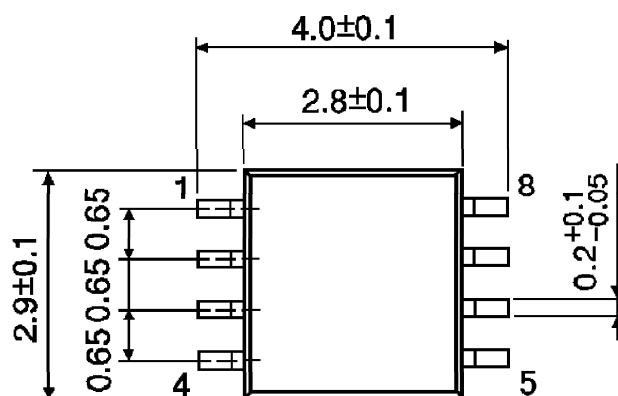


Weight : 0.05g (Typ.)



OUTLINE DRAWING  
SSOP8-P-0.65

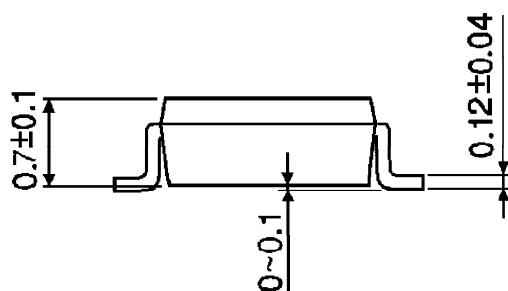
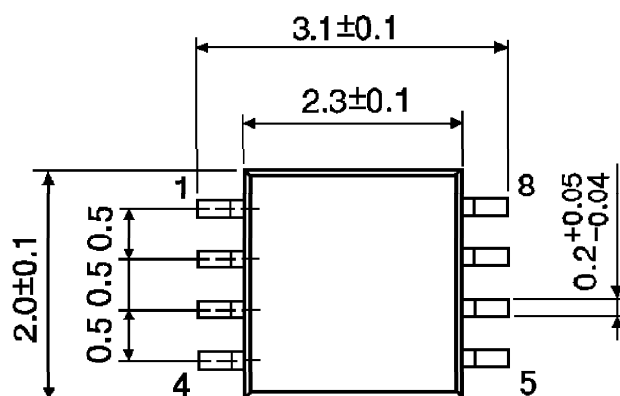
Unit : mm



Weight : 0.02g (Typ.)

OUTLINE DRAWING  
SSOP8-P-0.50A

Unit : mm



Weight : 0.01g (Typ.)