

TOSHIBA CMOS LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC75S51F, TC75S51FU

## SINGLE OPERATIONAL AMPLIFIER

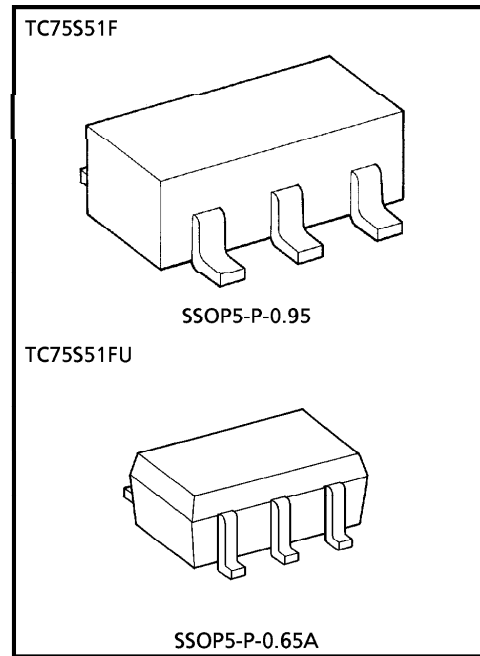
TC75S51F, TC75S51FU are CMOS operational amplifier with low supply voltage, low supply current.

### FEATURES

- Low supply voltage :  $V_{DD} = \pm 0.75 \sim \pm 3.5V$  or  $1.5 \sim 7V$
- Low supply current :  $I_{DD} (V_{DD} = 3V) = 60\mu A$  (Typ.)
- The internally phase compensated operational amplifier.
- Small package

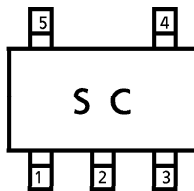
### MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC             | SYMBOL           | RATING               | UNIT |
|----------------------------|------------------|----------------------|------|
| Supply Voltage             | $V_{DD}, V_{SS}$ | 7                    | V    |
| Differential Input Voltage | $DV_{IN}$        | $\pm 7$              | V    |
| Input Voltage              | $V_{IN}$         | $V_{DD} \sim V_{SS}$ | V    |
| Power Dissipation          | $P_D$            | 200                  | mW   |
| Operating Temperature      | $T_{opr}$        | -40~85               | °C   |
| Storage Temperature        | $T_{stg}$        | -55~125              | °C   |

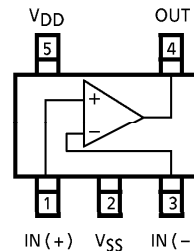


Weight  
 SSOP5-P-0.95 : 0.014g (Typ.)  
 SSOP5-P-0.65A : 0.006g (Typ.)

### MARKING (TOP VIEW)



### PIN CONNECTION (TOP VIEW)



961001EBA2

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## ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS ( $V_{DD} = 3.0V$ ,  $V_{SS} = GND$ ,  $T_a = 25^\circ C$ )

| CHARACTERISTIC                           | SYMBOL     | TEST CIR-CUIT | TEST CONDITION                        | MIN. | TYP. | MAX. | UNIT    |
|--|------------|---------------|---------------------------------------|------|------|------|---------|
| Input Offset Voltage                     | $V_{IO}$   | 1             | $R_S = 1k\Omega$ , $R_F = 100k\Omega$ | —    | 2    | 10   | mV      |
| Input Offset Current                     | $I_{IO}$   | —             | —                                     | —    | 1    | —    | pA      |
| Input Bias Current                       | $I_I$      | —             | —                                     | —    | 1    | —    | pA      |
| Common Mode Input Voltage                | $CMV_{IN}$ | 2             | $R_S = 1k\Omega$ , $R_F = 100k\Omega$ | 0    | —    | 2.5  | V       |
| Voltage Gain (Open Loop)                 | $G_V$      | —             | —                                     | 60   | 70   | —    | dB      |
| Maximum Output Voltage                   | $V_{OH}$   | 3             | $R_L \geq 100k\Omega$                 | 2.9  | —    | —    | V       |
|  | $V_{OL}$   | 4             | $R_L \geq 100k\Omega$                 | —    | —    | 0.1  | V       |
| Common Mode Input Signal Rejection Ratio | CMRR       | 2             | $V_{IN} = 0.0 \sim 2.5V$              | 55   | 65   | —    | dB      |
| Supply Voltage Rejection Ratio           | SVRR       | 1             | $V_{DD} = 1.5 \sim 7.0V$              | 60   | 70   | —    | dB      |
| Supply Current                           | $I_{DD}$   | 5             | —                                     | —    | 60   | 200  | $\mu A$ |

DC CHARACTERISTICS ( $V_{DD} = 1.5V$ ,  $V_{SS} = GND$ ,  $T_a = 25^\circ C$ )

| CHARACTERISTIC            | SYMBOL     | TEST CIR-CUIT | TEST CONDITION                         | MIN. | TYP. | MAX. | UNIT    |
|---------------------------|------------|---------------|--|------|------|------|---------|
| Input Offset Voltage      | $V_{IO}$   | 1             | $R_S = 10k\Omega$ , $R_F = 100k\Omega$ | —    | 2    | 10   | mV      |
| Input Offset Current      | $I_{IO}$   | —             | —                                      | —    | 1    | —    | pA      |
| Input Bias Current        | $I_I$      | —             | —                                      | —    | 1    | —    | pA      |
| Common Mode Input Voltage | $CMV_{IN}$ | 2             | $R_S = 10k\Omega$ , $R_F = 100k\Omega$ | 0    | —    | 1.0  | V       |
| Voltage Gain (Open Loop)  | $G_V$      | —             | —                                      | 60   | 70   | —    | dB      |
| Maximum Output Voltage    | $V_{OH}$   | 3             | $R_L \geq 100k\Omega$                  | 1.4  | —    | —    | V       |
|                           | $V_{OL}$   | 4             | $R_L \geq 100k\Omega$                  | —    | —    | 0.1  | V       |
| Supply Current            | $I_{DD}$   | 5             | —                                      | —    | 50   | 150  | $\mu A$ |

(Note) This device should be operated less than  $70\mu A$  source current.AC CHARACTERISTICS ( $V_{DD} = 3.0V$ ,  $V_{SS} = GND$ ,  $T_a = 25^\circ C$ )

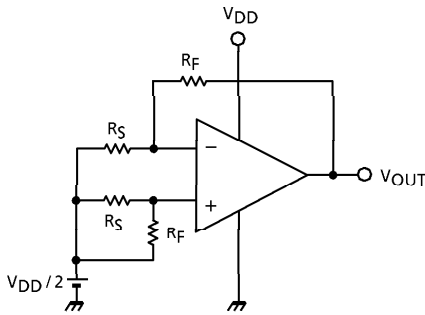
| CHARACTERISTIC             | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT        |
|----------------------------|--------|---------------|----------------|------|------|------|-------------|
| Slew Rate                  | SR     | —             | $A_V = 0dB$    | —    | 0.5  | —    | $V / \mu s$ |
| Unity Gain Cross Frequency | $f_T$  | —             | $A_V = 40dB$   | —    | 0.6  | —    | MHz         |

AC CHARACTERISTICS ( $V_{DD} = 1.5V$ ,  $V_{SS} = GND$ ,  $T_a = 25^\circ C$ )

| CHARACTERISTIC             | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT        |
|----------------------------|--------|---------------|----------------|------|------|------|-------------|
| Slew Rate                  | SR     | —             | $A_V = 0dB$    | —    | 0.3  | —    | $V / \mu s$ |
| Unity Gain Cross Frequency | $f_T$  | —             | $A_V = 40dB$   | —    | 0.5  | —    | MHz         |

TEST CIRCUIT

1. SVRR,  $V_{IO}$



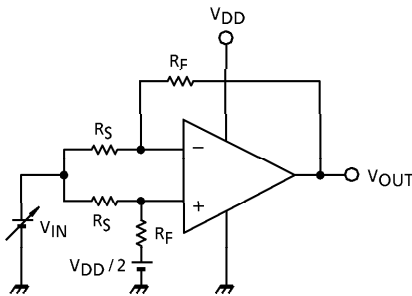
- SVRR  
 $V_{DD} = 1.5V : V_{DD} = V_{DD1}, V_{OUT} = V_{OUT1}$   
 $V_{DD} = 7.0V : V_{DD} = V_{DD2}, V_{OUT} = V_{OUT2}$   

$$SVRR = 20 \log \left( \left| \frac{V_{OUT1} - V_{OUT2}}{V_{DD1} - V_{DD2}} \right| \times \frac{R_S}{R_F + R_S} \right)$$

- $V_{IO}$   

$$V_{IO} = \left( V_{OUT} - \frac{V_{DD}}{2} \right) \times \frac{R_S}{R_F + R_S}$$

2. CMRR,  $CMV_{IN}$

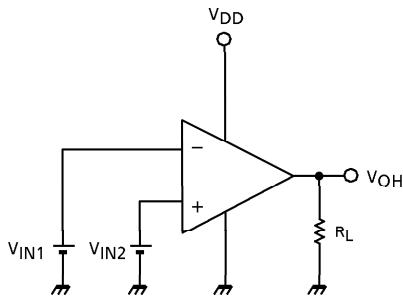


- CMRR  
 $V_{IN} = 0.0V : V_{IN} = V_{IN1}, V_{OUT} = V_{OUT1}$   
 $V_{IN} = 2.5V : V_{IN} = V_{IN2}, V_{OUT} = V_{OUT2}$   

$$CMRR = 20 \log \left( \left| \frac{V_{OUT1} - V_{OUT2}}{V_{IN1} - V_{IN2}} \right| \times \frac{R_S}{R_F + R_S} \right)$$

- $CMV_{IN}$

3.  $V_{OH}$

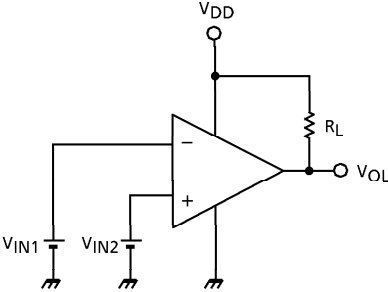


- $V_{OH}$   

$$V_{IN1} = \frac{V_{DD}}{2} - 0.05V$$
  

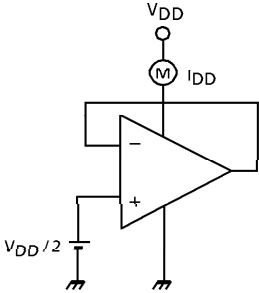
$$V_{IN2} = \frac{V_{DD}}{2} + 0.05V$$

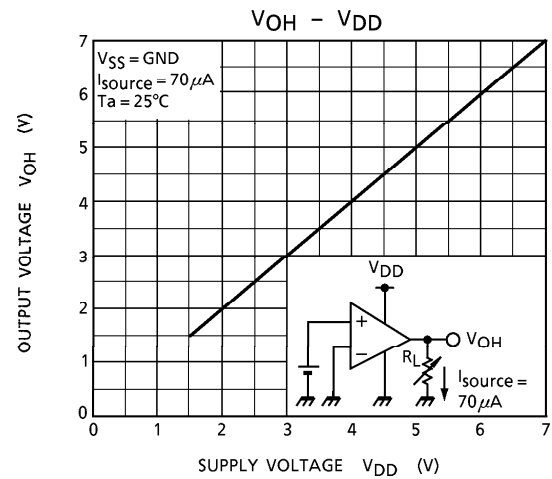
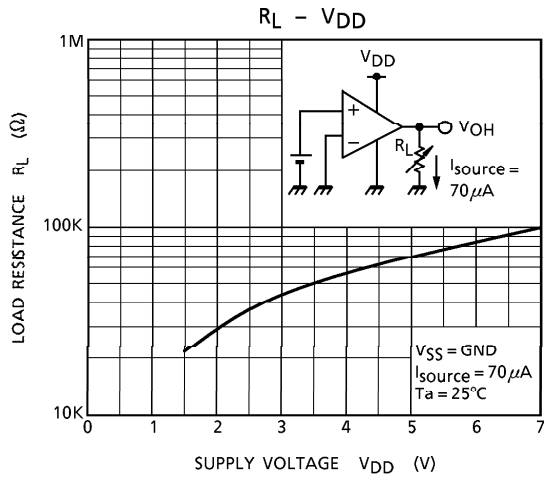
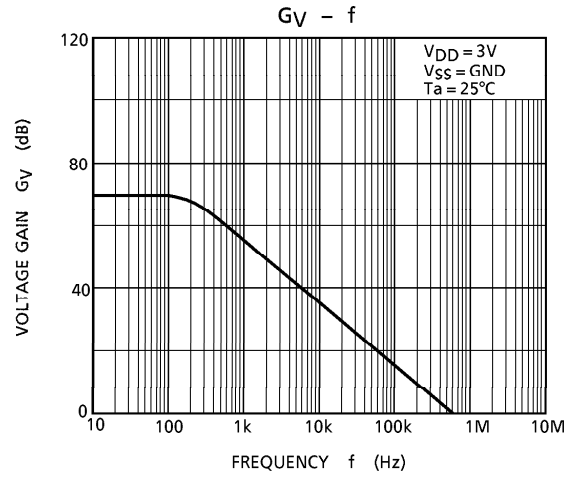
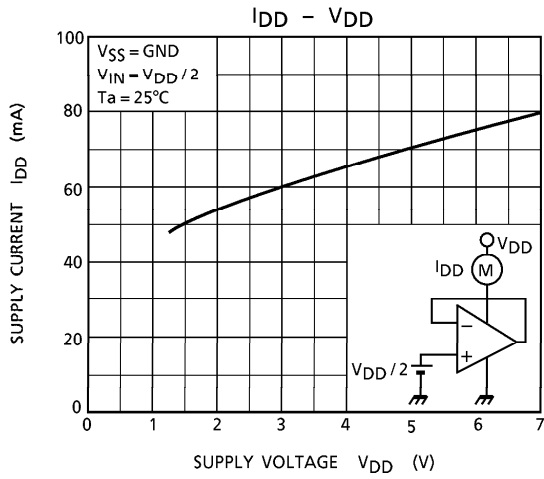
4. VOL

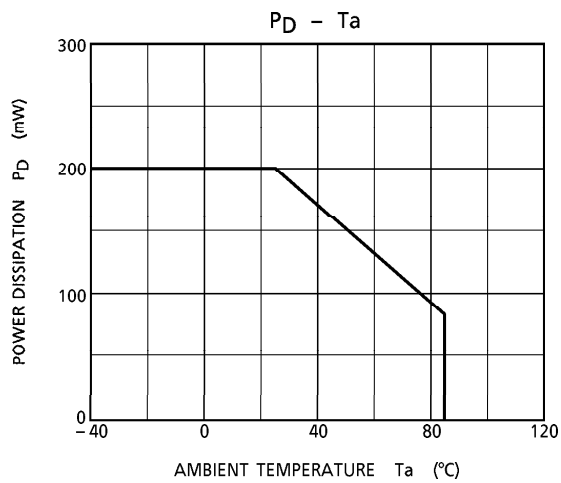
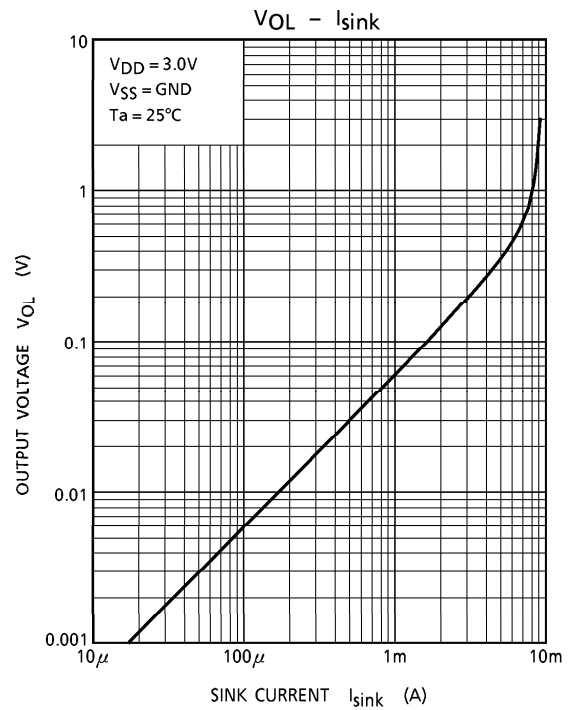
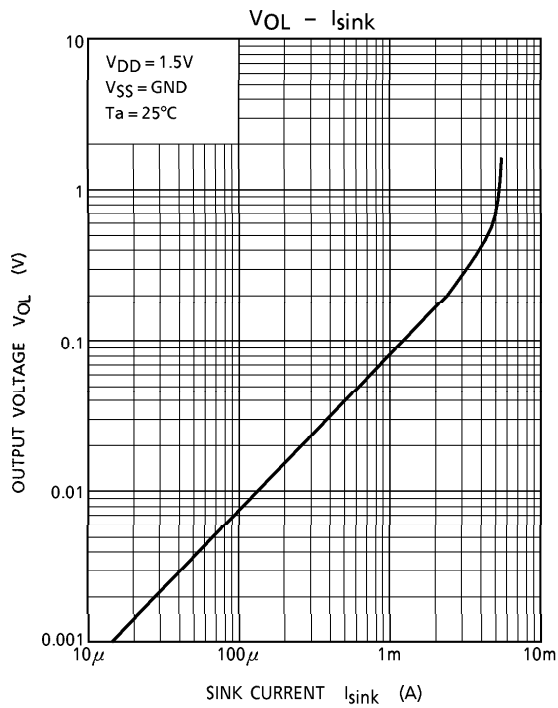


- VOL
$$V_{IN1} = \frac{V_{DD}}{2} + 0.05V$$
$$V_{IN2} = \frac{V_{DD}}{2} - 0.05V$$

5. IDD

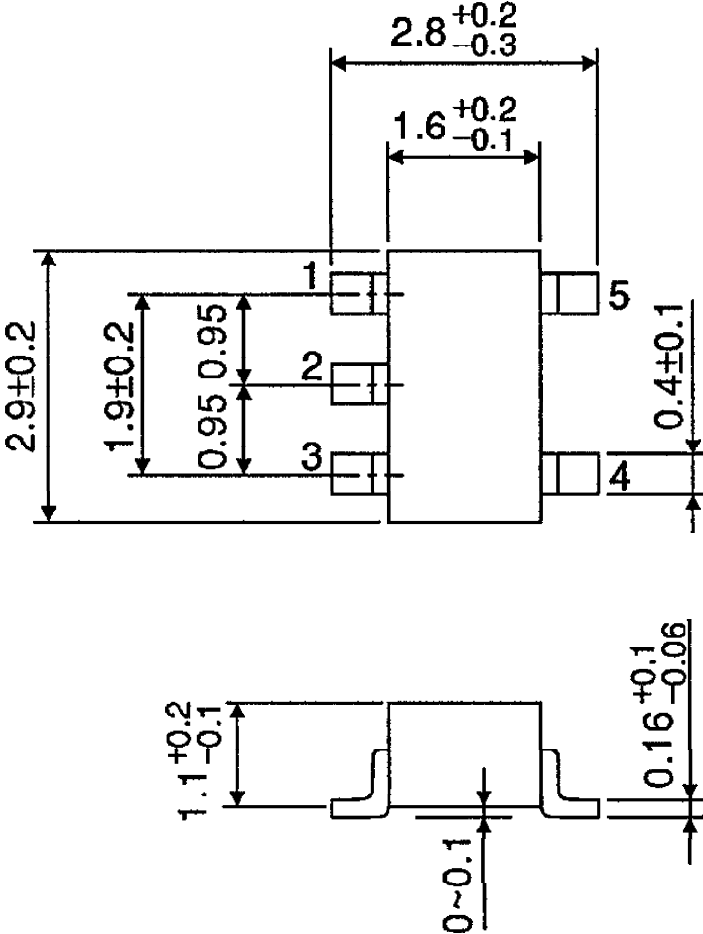






OUTLINE DRAWING  
SSOP5-P-0.95

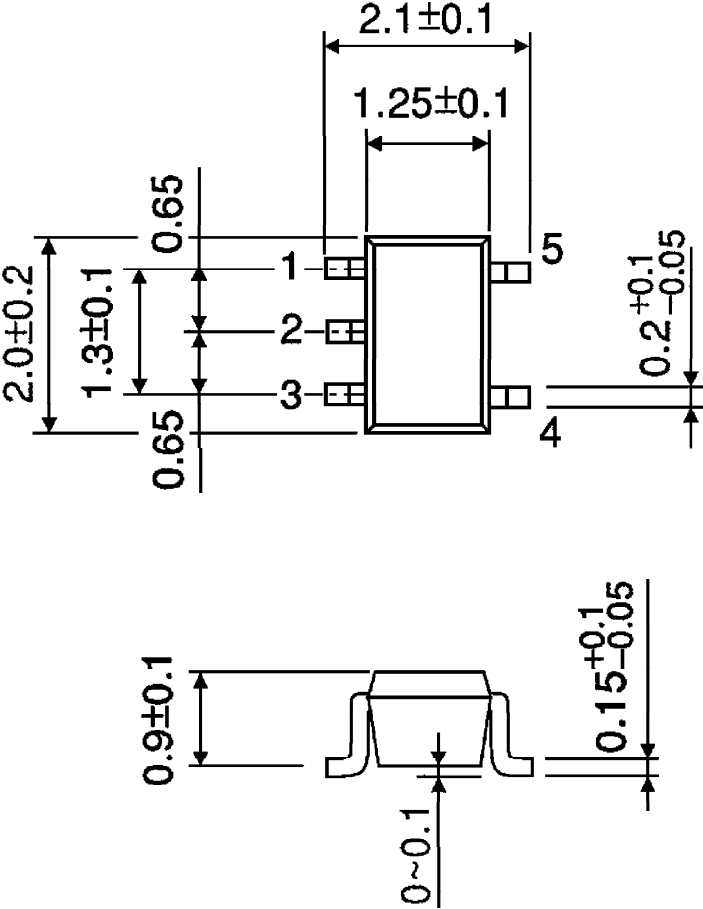
Unit : mm



Weight : 0.014g (Typ.)

OUTLINE DRAWING  
SSOP5-P-0.65A

Unit : mm



Weight : 0.006g (Typ.)