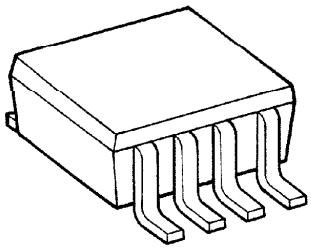
TOSHIBA CMOS LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC75W51FU, TC75W51FK

## DUAL OPERATIONAL AMPLIFIER

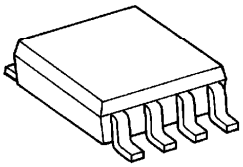
TC75W51 is a CMOS operational amplifier with low supply voltage, low supply current.

TC75W51FU



SSOP8-P-0.65

TC75W51FK



SSOP8-P-0.50A

Weight
SSOP8-P-0.65 : 0.021g (Typ.)
SSOP8-P-0.50A : 0.01g (Typ.)

### FEATURES

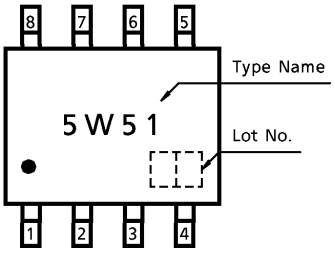
- Low supply voltage : $V_{DD} = \pm 0.75 \sim \pm 3.5V$ or $1.5 \sim 7V$
- Low supply current : $I_{DD}$ ($V_{DD} = 3V$) = 120$\mu$A (Typ.)
- The internally phase compensated operational amplifier.
- Small package

### MAXIMUM RATINGS (Ta = 25°C)

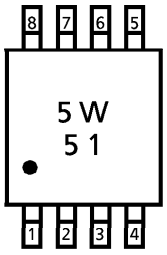
| CHARACTERISTIC | SYMBOL | RATING | N |
|---|---|---|---|
| Supply Voltage | $V_{DD}$, $V_{SS}$ | 7 | V |
| Differential Input Voltage | $DV_{IN}$ | ±7 | V |
| Input Voltage | $V_{IN}$ | $V_{DD} \sim V_{SS}$ | V |
| Power Dissipation | $P_D$ | 250 (SM8) | mW |
| | | 200 (US8) | |
| Operating Temperature | $T_{opr}$ | −40~85 | °C |
| Storage Temperature | $T_{stg}$ | −55~125 | °C |

### MARKING (TOP VIEW)

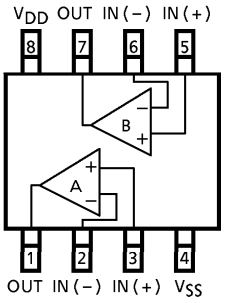
SM8




US8




### PIN CONNECTION (TOP VIEW)



**ELECTRICAL CHARACTERISTICS**

DC CHARACTERISTICS ($V_{DD}$ = 3.0V, $V_{SS}$ = GND, Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | 1 | $R_S$ = 1kΩ, $R_F$ = 100kΩ | — | 2 | 10 | mV |
| Input Offset Current | $I_{IO}$ | — | — | — | 1 | — | pA |
| Input Bias Current | $I_I$ | — | — | — | 1 | — | pA |
| Common Mode Input Voltage | $CMV_{IN}$ | 2 | $R_S$ = 1kΩ, $R_F$ = 100kΩ | 0 | — | 2.5 | V |
| Voltage Gain (Open Loop) | $G_V$ | — | — | 60 | 70 | — | dB |
| Maximum Output Voltage | $V_{OH}$ | 3 | $R_L \geqq$ 100kΩ | 2.9 | — | — | V |
| | $V_{OL}$ | 4 | $R_L \geqq$ 100kΩ | — | — | 0.1 | V |
| Common Mode Input Signal Rejection Ratio | CMRR | 2 | $V_{IN}$ = 0.0~2.5V | 55 | 65 | — | dB |
| Supply Voltage Rejection Ratio | SVRR | 1 | $V_{DD}$ = 1.5~7.0V | 60 | 70 | — | dB |
| Supply Current | $I_{DD}$ | 5 | — | — | 120 | 400 | μA |

DC CHARACTERISTICS ($V_{DD}$ = 1.5V, $V_{SS}$ = GND, Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | 1 | $R_S$ = 10kΩ, $R_F$ = 100kΩ | — | 2 | 10 | mV |
| Input Offset Current | $I_{IO}$ | — | — | — | 1 | — | pA |
| Input Bias Current | $I_I$ | — | — | — | 1 | — | pA |
| Common Mode Input Voltage | $CMV_{IN}$ | 2 | $R_S$ = 10kΩ, $R_F$ = 100kΩ | 0 | — | 1.0 | V |
| Voltage Gain (Open Loop) | $G_V$ | — | — | 60 | 70 | — | dB |
| Maximum Output Voltage | $V_{OH}$ | 3 | $R_L \geqq$ 100kΩ | 1.4 | — | — | V |
| | $V_{OL}$ | 4 | $R_L \geqq$ 100kΩ | — | — | 0.1 | V |
| Supply Current | $I_{DD}$ | 5 | — | — | 100 | 300 | μA |

(Note) This device should be operated less than 70μA source current.

AC CHARACTERISTICS ($V_{DD}$ = 3.0V, $V_{SS}$ = GND, Ta = 25°C)

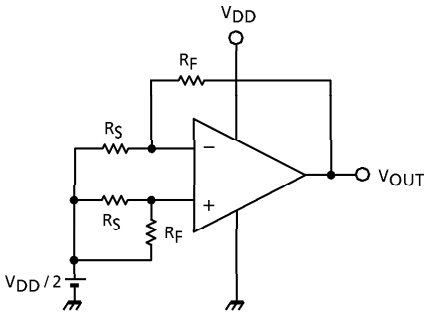
| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Slew Rate | SR | — | $A_V$ = 0dB | — | 0.5 | — | V / μs |
| Unity Gain Cross Frequency | $f_T$ | — | $A_V$ = 40dB | — | 0.6 | — | MHz |

AC CHARACTERISTICS ($V_{DD}$ = 1.5V, $V_{SS}$ = GND, Ta = 25°C)

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

**TEST CIRCUIT**

1. SVRR, $V_{IO}$




- SVRR

  $V_{DD} = 1.5V$ : $V_{DD} = V_{DD}1$, $V_{OUT} = V_{OUT}1$

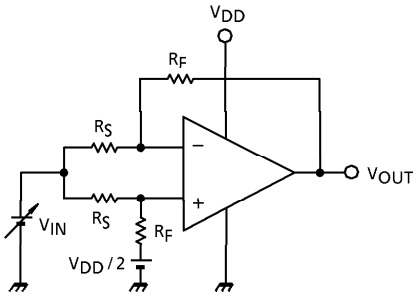
  $V_{DD} = 7.0V$ : $V_{DD} = V_{DD}2$, $V_{OUT} = V_{OUT}2$

$$SVRR = 20\ell og\left(\left|\frac{V_{OUT}1 - V_{OUT}2}{V_{DD}1 - V_{DD}2}\right| \times \frac{R_S}{R_F + R_S}\right)$$

- $V_{IO}$

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

2. CMRR, $CMV_{IN}$




- CMRR

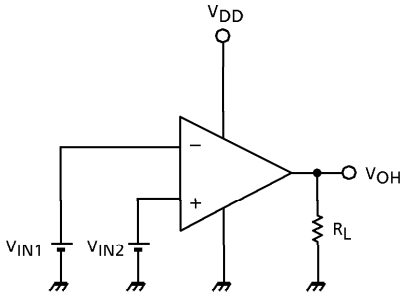
  $V_{IN} = 0.0V$ : $V_{IN} = V_{IN}1$, $V_{OUT} = V_{OUT}1$

  $V_{IN} = 2.5V$ : $V_{IN} = V_{IN}2$, $V_{OUT} = V_{OUT}2$

$$CMRR = 20\ell og\left(\left|\frac{V_{OUT}1 - V_{OUT}2}{V_{IN}1 - V_{IN}2}\right| \times \frac{R_S}{R_F + R_S}\right)$$

- $CMV_{IN}$

3. $V_{OH}$

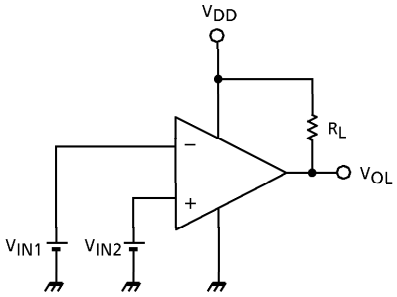



- $V_{OH}$

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

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

4. $V_{OL}$

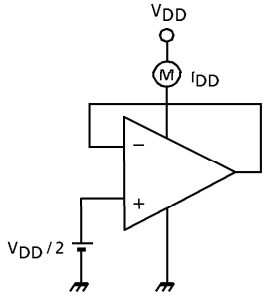



- $V_{OL}$

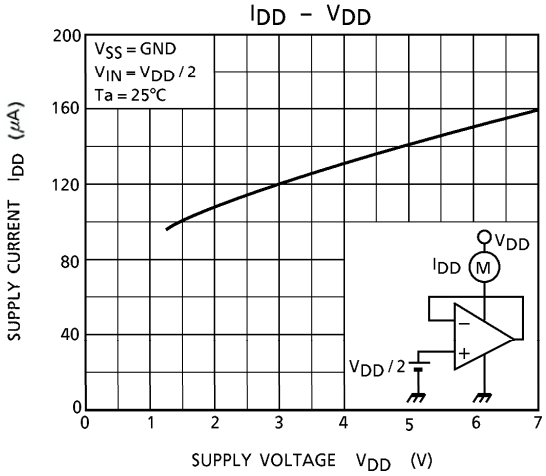
$$V_{IN1} = \frac{V_{DD}}{2} + 0.05V$$

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

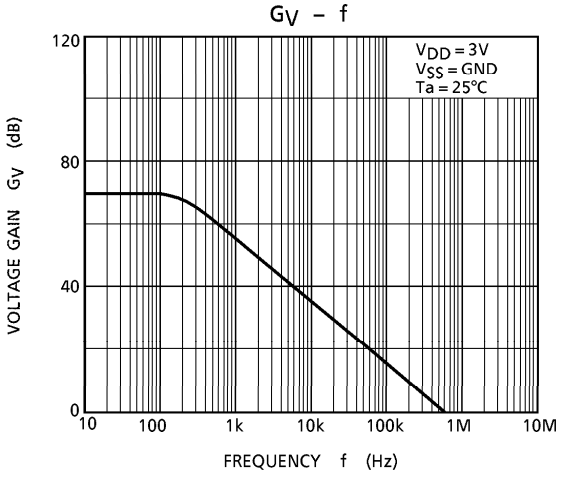
5. $I_{DD}$



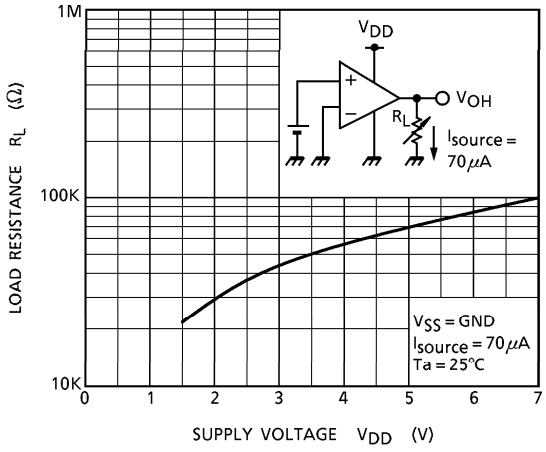
$I_{DD}$ – $V_{DD}$



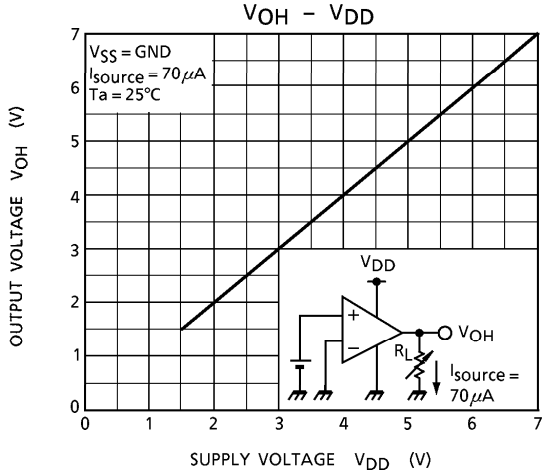

$G_V$ – f

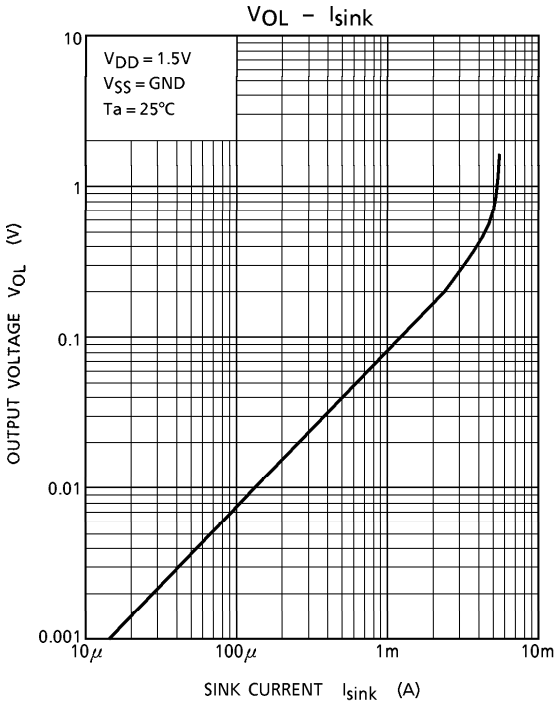


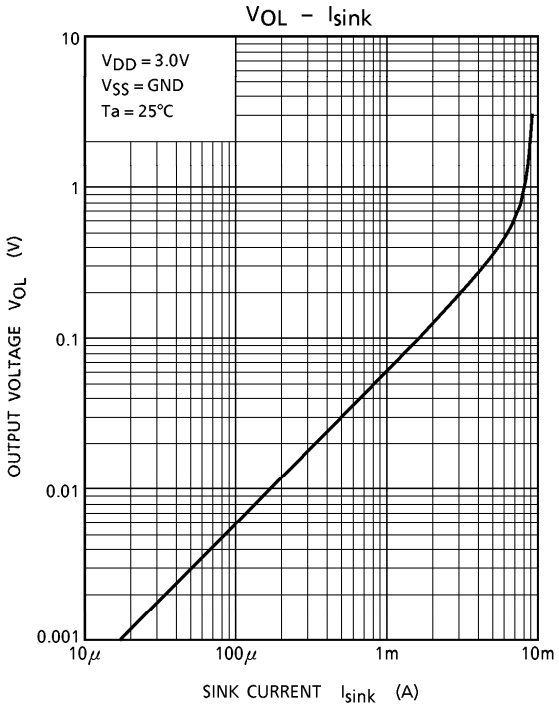

$R_L$ – $V_{DD}$

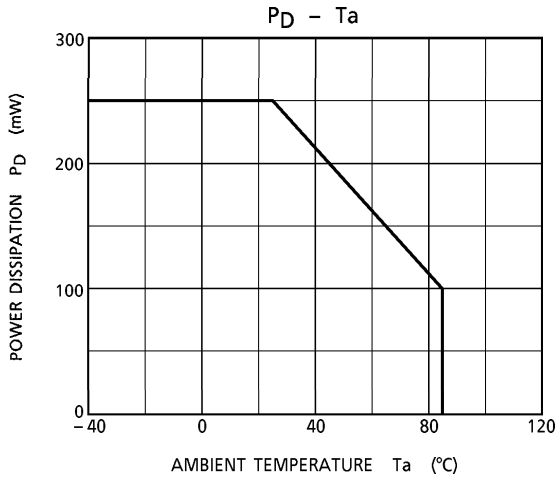



$V_{OH}$ – $V_{DD}$




$V_{OL}$ – $I_{sink}$
$V_{DD}$ = 1.5V
$V_{SS}$ = GND
Ta = 25°C
OUTPUT VOLTAGE $V_{OL}$ (V)
10
1
0.1
0.01
0.001
10μ
100μ
1m
10m
SINK CURRENT $I_{sink}$ (A)

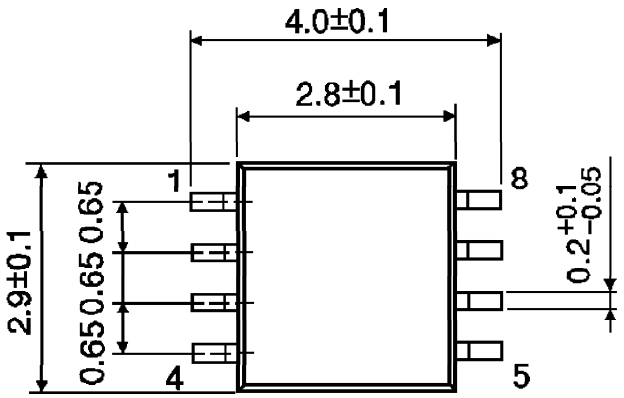

$V_{OL}$ – $I_{sink}$
$V_{DD}$ = 3.0V
$V_{SS}$ = GND
Ta = 25°C
OUTPUT VOLTAGE $V_{OL}$ (V)
10
1
0.1
0.01
0.001
10μ
100μ
1m
10m
SINK CURRENT $I_{sink}$ (A)

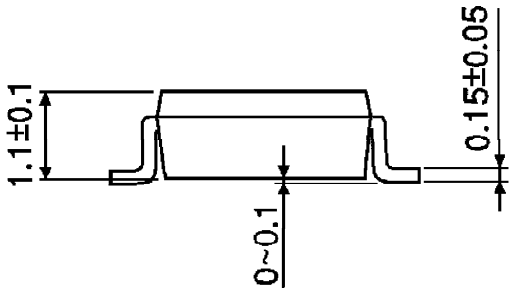

$P_D$ – Ta
POWER DISSIPATION $P_D$ (mW)
300
200
100
0
– 40
0
40
80
120
AMBIENT TEMPERATURE Ta (°C)

**OUTLINE DRAWING**

SSOP8-P-0.65

Unit : mm



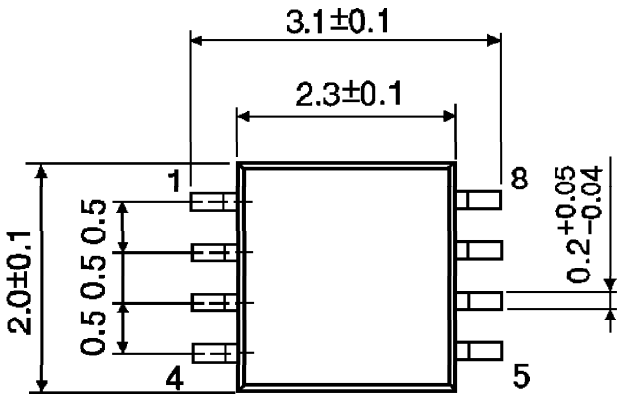



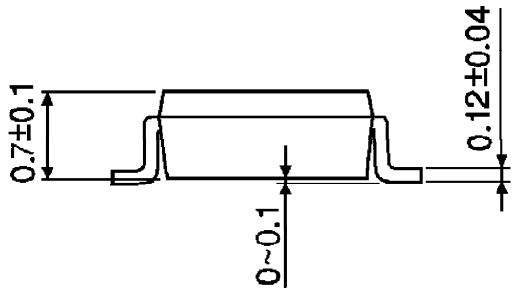

Weight : 0.021g (Typ.)

**OUTLINE DRAWING**

SSOP8-P-0.50A

Unit : mm




Weight : 0.01g (Typ.)

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