

TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

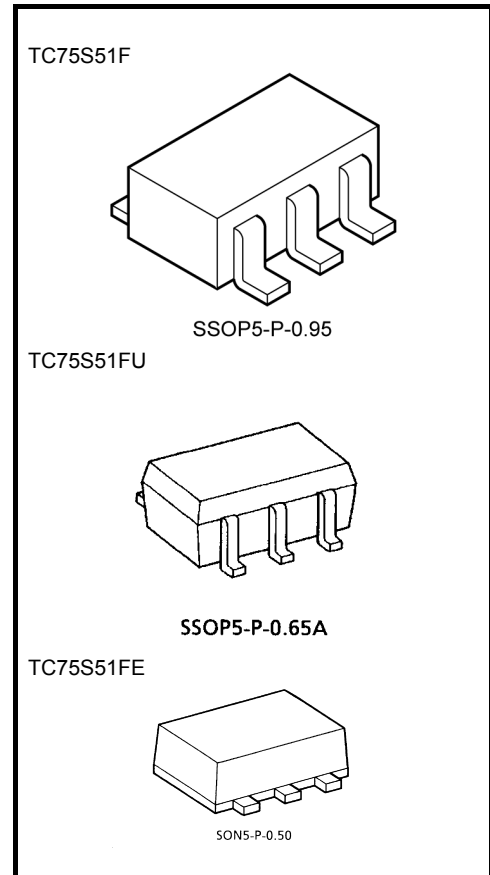
# TC75S51F, TC75S51FU, TC75S51FE

## Single Operational Amplifier

The TC75S51F/TC75S51FU/TC75S51FE is a CMOS single-operation amplifier which incorporates a phase compensation circuit. It is designed for use with a low-voltage, low-current power supply; this differentiates this device from conventional general-purpose bipolar op-amps.

### Features

- Low-voltage operation :  $V_{DD} = \pm 0.75 \sim \pm 3.5$  V or 1.5~7 V
- Low-current power supply :  $I_{DD} (V_{DD} = 3$  V) = 60  $\mu$ A (typ.)
- Built-in phase-compensated op-amp, obviating the need for any external device
- Ultra-compact package



Weight  
 SSOP5-P-0.95 : 0.014 g (typ.)  
 SSOP5-P-0.65A : 0.006 g (typ.)  
 SON5-P-0.50 : 0.003 g (typ.)

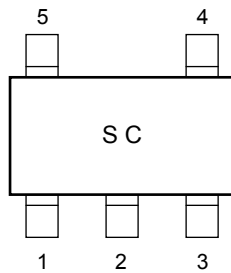
### Absolute Maximum Ratings (Ta = 25°C)

Characteristics	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	TC75S51F/FU	$P_D$	mW
	TC75S51FE		
Operating temperature	$T_{opr}$	-40~85	°C
Storage temperature	$T_{stg}$	-55~125	°C

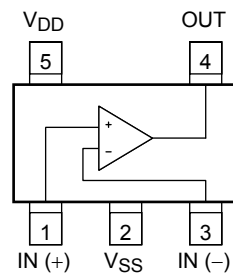
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

## Marking (top view)



## Pin Connection (top view)



## Electrical Characteristics

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

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input offset voltage	$V_{IO}$	1	$R_S = 1\text{ k}\Omega$ , $R_F = 100\text{ k}\Omega$	—	2	10	mV
Input offset current	$I_{IO}$	—	—	—	1	—	pA
Input bias current	$I_I$	—	—	—	1	—	pA
Common mode input voltage	$CMV_{IN}$	2	$R_S = 1\text{ k}\Omega$ , $R_F = 100\text{ k}\Omega$	0	—	2.5	V
Voltage gain (open loop)	$G_V$	—	—	60	70	—	dB
Maximum output voltage	$V_{OH}$	3	$R_L \geq 100\text{ k}\Omega$	2.9	—	—	V
	$V_{OL}$	4	$R_L \geq 100\text{ k}\Omega$	—	—	0.1	
Common mode input signal rejection ratio	CMRR	2	$V_{IN} = 0.0\sim 2.5\text{ V}$	55	65	—	dB
Supply voltage rejection ratio	SVRR	1	$V_{DD} = 1.5\sim 7.0\text{ V}$	60	70	—	dB
Supply current	$I_{DD}$	5	—	—	60	200	$\mu\text{A}$

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

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input offset voltage	$V_{IO}$	1	$R_S = 10\text{ k}\Omega$ , $R_F = 100\text{ k}\Omega$	—	2	10	mV
Input offset current	$I_{IO}$	—	—	—	1	—	pA
Input bias current	$I_I$	—	—	—	1	—	pA
Common mode input voltage	$CMV_{IN}$	2	$R_S = 10\text{ k}\Omega$ , $R_F = 100\text{ k}\Omega$	0	—	1.0	V
Voltage gain (open loop)	$G_V$	—	—	60	70	—	dB
Maximum output voltage	$V_{OH}$	3	$R_L \geq 100\text{ k}\Omega$	1.4	—	—	V
	$V_{OL}$	4	$R_L \geq 100\text{ k}\Omega$	—	—	0.1	
Supply current	$I_{DD}$	5	—	—	50	150	$\mu\text{A}$

Note: For this device, please use a source current of no more than 70  $\mu\text{A}$ .

## AC Characteristics ( $V_{DD} = 3.0\text{ V}$ , $V_{SS} = \text{GND}$ , $T_a = 25^\circ\text{C}$ )

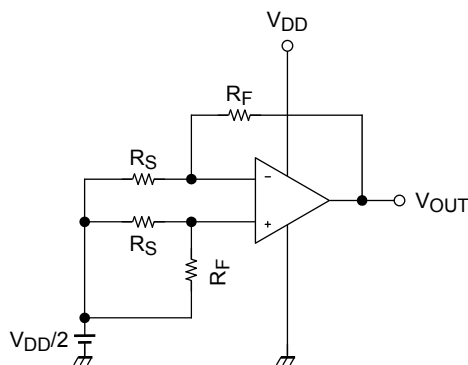
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Slew rate	SR	—	$A_V = 0\text{ dB}$	—	0.5	—	$\text{V}/\mu\text{s}$
Unity gain cross frequency	$f_T$	—	$A_V = 40\text{ dB}$	—	0.6	—	MHz

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

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Slew rate	SR	—	$A_V = 0\text{ dB}$	—	0.3	—	$\text{V}/\mu\text{s}$
Unity gain cross frequency	$f_T$	—	$A_V = 40\text{ dB}$	—	0.5	—	MHz

## Test Circuit

### 1. SVRR, $V_{IO}$



- SVRR**  
 For each of the two  $V_{DD}$  values, measure the  $V_{OUT}$  value, as indicated below, and calculate the value of SVRR using the equation shown.

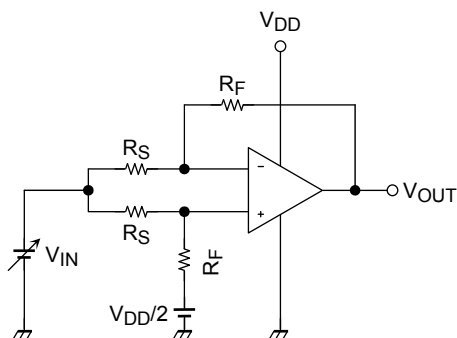
When  $V_{DD} = 1.5\text{ V}$ ,  $V_{DD} = V_{DD1}$  and  $V_{OUT} = V_{OUT1}$   
 When  $V_{DD} = 7.0\text{ V}$ ,  $V_{DD} = V_{DD2}$  and  $V_{OUT} = V_{OUT2}$

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

- $V_{IO}$**   
 Measure the value of  $V_{OUT}$  and calculate the value of  $V_{IO}$  using the following equation.

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

### 2. CMRR, $CMV_{IN}$



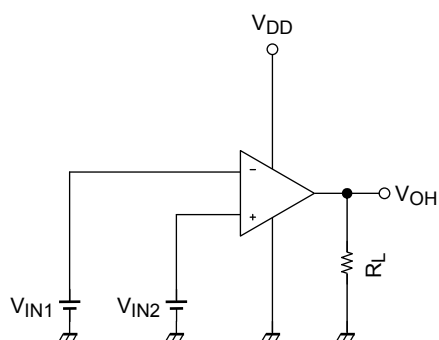
- CMRR**  
 Measure the  $V_{OUT}$  value, as indicated below, and calculate the value of the CMRR using the equation shown.

When  $V_{IN} = 0.0\text{ V}$ ,  $V_{IN} = V_{IN1}$  and  $V_{OUT} = V_{OUT1}$   
 When  $V_{IN} = 2.5\text{ V}$ ,  $V_{IN} = V_{IN2}$  and  $V_{OUT} = V_{OUT2}$

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

- $CMV_{IN}$**   
 Input range within which the CMRR specification guarantees  $V_{OUT}$  value (as varied by the  $V_{IN}$  value).

**3. V<sub>OH</sub>**

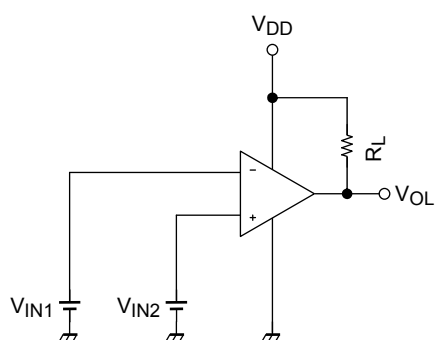


- V<sub>OH</sub>  

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

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

**4. V<sub>OL</sub>**

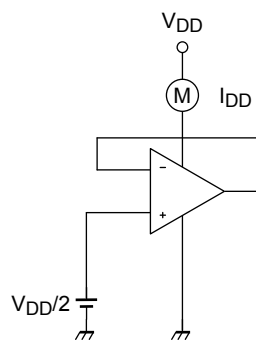


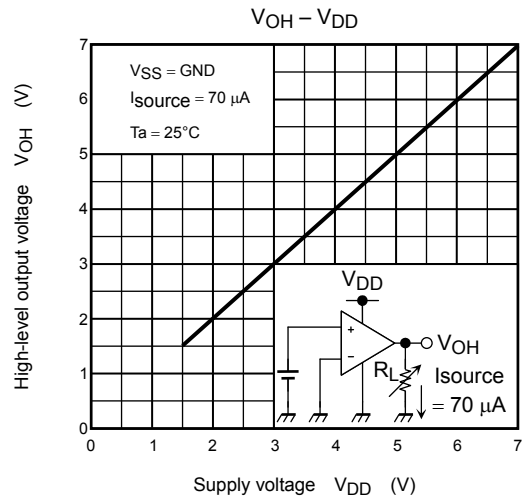
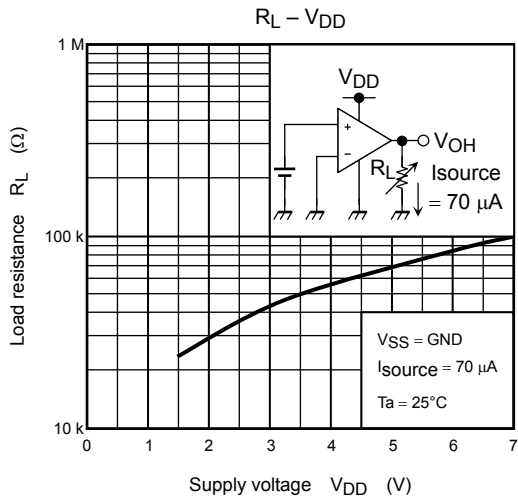
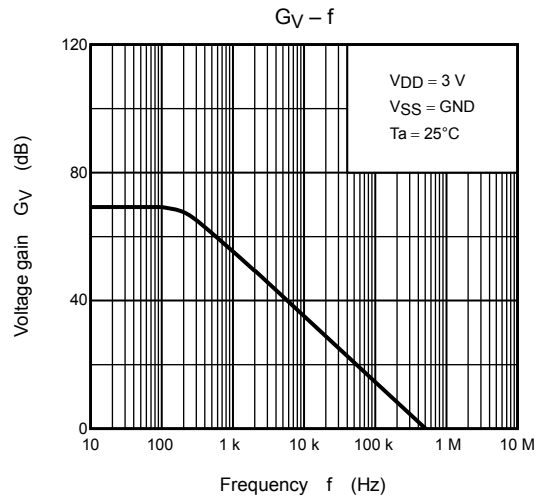
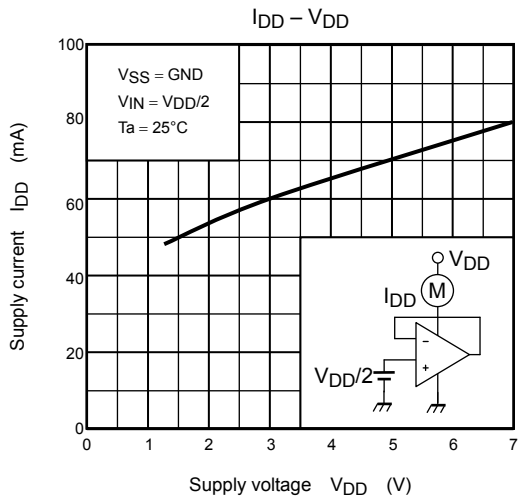
- V<sub>OL</sub>  

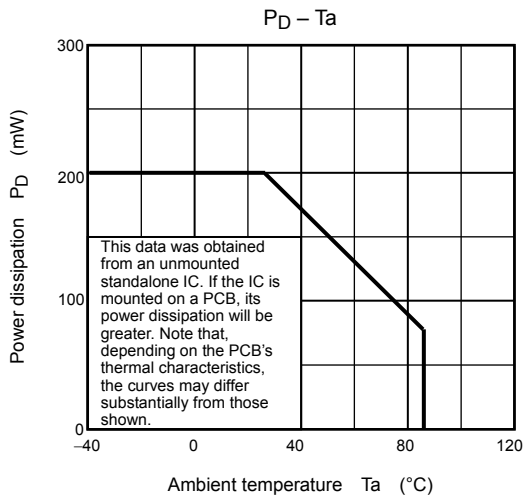
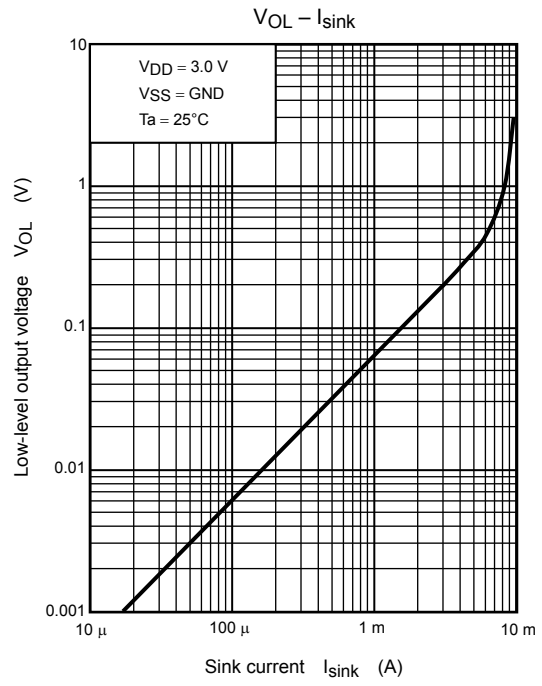
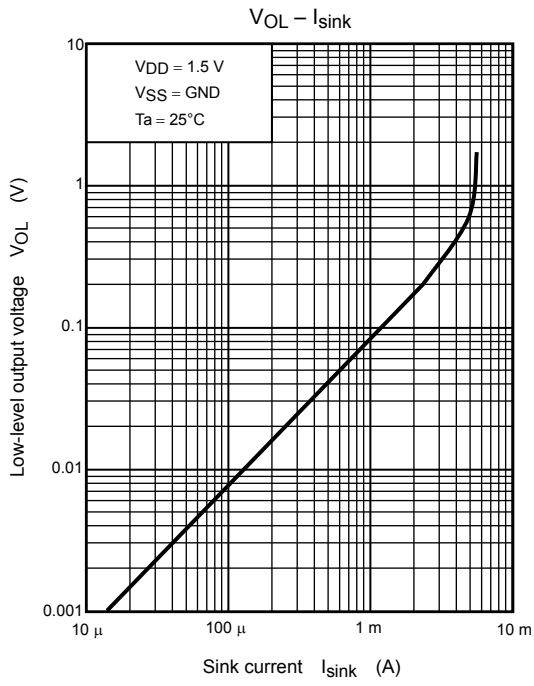
$$V_{IN1} = \frac{V_{DD}}{2} + 0.05 \text{ V}$$

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

**5. I<sub>DD</sub>**



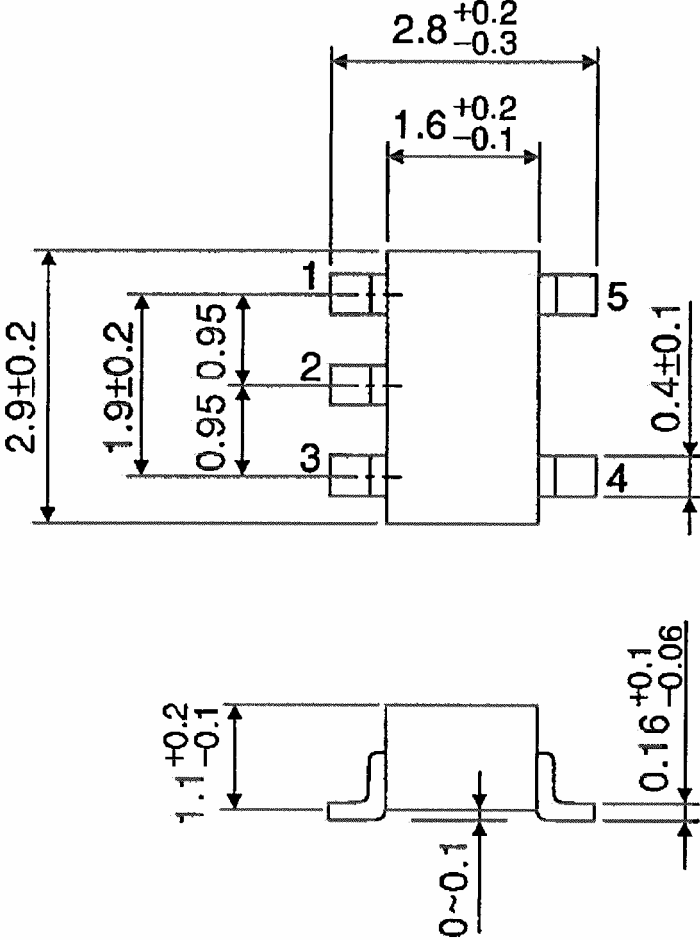




Package Dimensions

SSOP5-P-0.95

Unit : mm

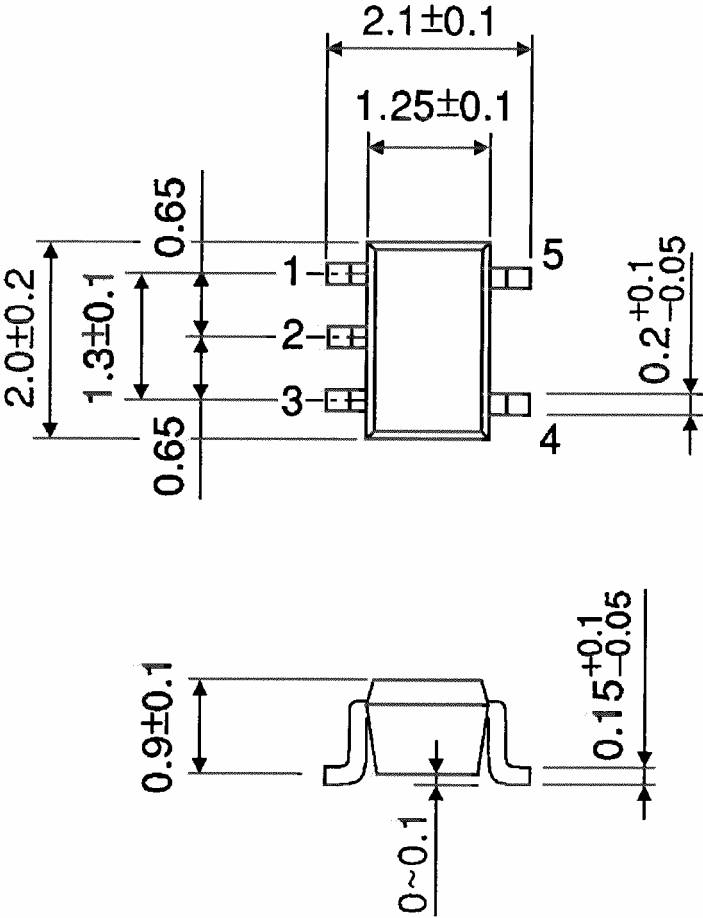


Weight: 0.014 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



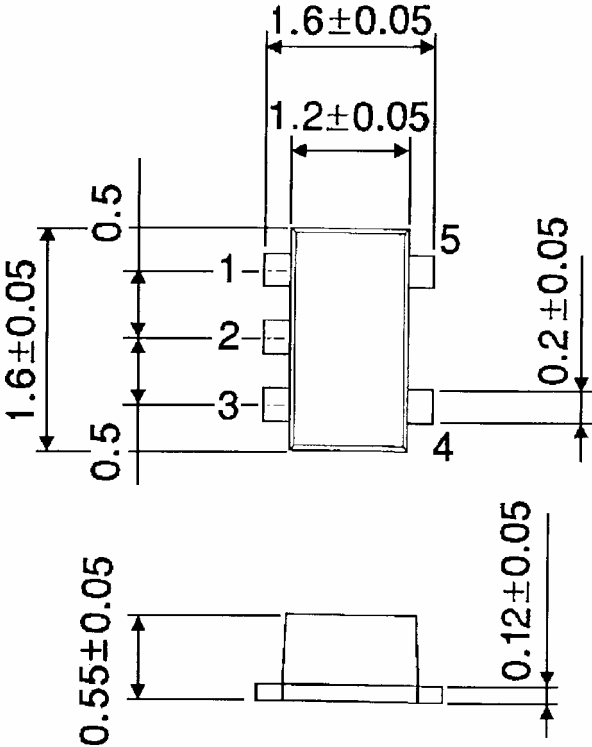
Weight: 0.006 g (typ.)



**Package Dimensions**

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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20070701-EN GENERAL

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