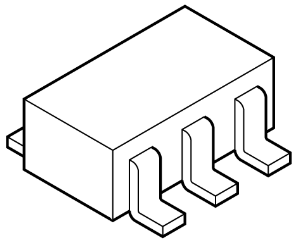
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TC75S51F, TC75S51FU, TC75S51FE

Single Operational Amplifier

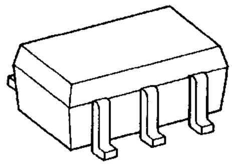
The TC75S51F/TC75S51FU/TC75S51FE is a CMOS single-operation amplifier which incorporates a phase compensation circuit. It is designed with a low-voltage and low-current power supply; this differentiates this device from general-purpose bipolar op-amps.

TC75S51F



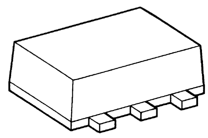
SSOP5-P-0.95 (SMV)

TC75S51FU



SSOP5-P-0.65A (USV)

TC75S51FE



SON5-P-0.50 (ESV)

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.)

Features

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

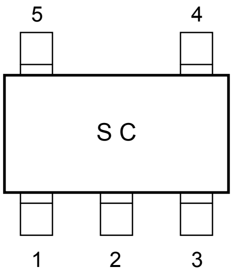
Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Supply voltage		V_{DD}, V_{SS}	7	V
Differential input voltage		DV_{IN}	±7	V
Input voltage		V_{IN}	V_{DD} to V_{SS}	V
Power dissipation	TC75S51F/FU	P_D	200	mW
	TC75S51FE		100	
Operating temperature		T_{opr}	−40 to 85	°C
Storage temperature		T_{stg}	−55 to 125	°C

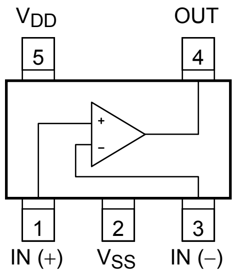
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Start of commercial production
1993-07

Marking (top view)



Pin Connection (top view)



Electrical Characteristics

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

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input offset voltage		V_{IO}	1	R_S = 1 kΩ, R_F = 100 kΩ	—	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 kΩ, R_F = 100 kΩ	0	—	2.5	V
Voltage gain (open loop)		G_V	—	—	60	70	—	dB
Maximum output voltage		V_{OH}	3	R_L ≥ 100 kΩ	2.9	—	—	V
		V_{OL}	4	R_L ≥ 100 kΩ	—	—	0.1	
Common mode input signal rejection ratio		CMRR	2	V_{IN} = 0.0 to 2.5 V	55	65	—	dB
Supply voltage rejection ratio		SVRR	1	V_{DD} = 1.5 to 7.0 V	60	70	—	dB
Supply current		I_{DD}	5	—	—	60	200	μA

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

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input offset voltage		V_{IO}	1	R_S = 10 kΩ, R_F = 100 kΩ	—	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 kΩ, R_F = 100 kΩ	0	—	1.0	V
Voltage gain (open loop)		G_V	—	—	60	70	—	dB
Maximum output voltage		V_{OH}	3	R_L ≥ 100 kΩ	1.4	—	—	V
		V_{OL}	4	R_L ≥ 100 kΩ	—	—	0.1	
Supply current		I_{DD}	5	—	—	50	150	μA

Note: For this device, please use a source current of no more than 70 μA.

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

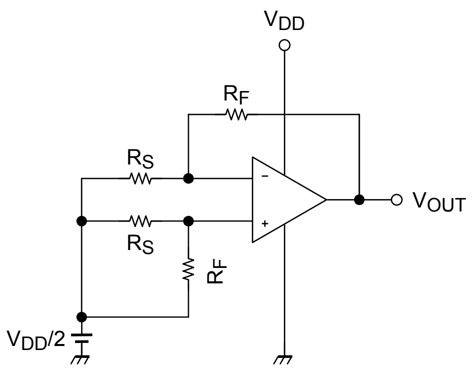
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Slew rate	SR	—	A_V = 0 dB	—	0.5	—	V/μs
Unity gain cross frequency	f_T	—	A_V = 40 dB	—	0.6	—	MHz

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

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Slew rate	SR	—	A_V = 0 dB	—	0.3	—	V/μs
Unity gain cross frequency	f_T	—	A_V = 40 dB	—	0.5	—	MHz

Test Circuit

1. SVRR, V_{IO}



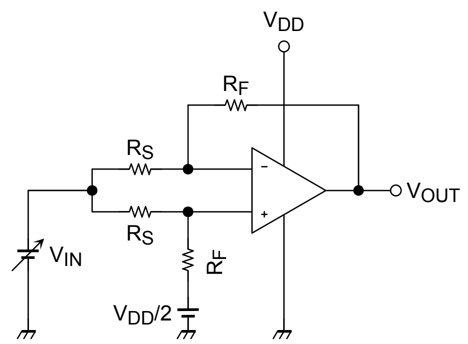
- SVRR
  For each of the two V_{DD} values, measure the V_{OUT} value, as indicated below, and calculate the value of SVRR using the equation shown.
  When V_{DD} = 1.5 V, V_{DD} = $V_{DD}1$ and V_{OUT} = $V_{OUT}1$
  When V_{DD} = 7.0 V, V_{DD} = $V_{DD}2$ and V_{OUT} = $V_{OUT}2$

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

- V_{IO}
  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}

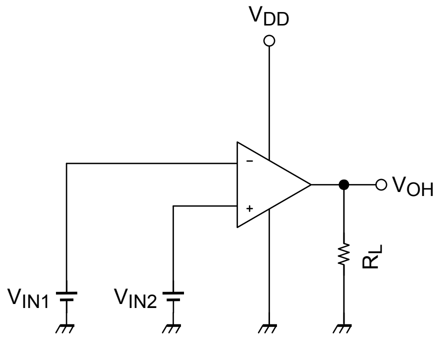


- CMRR
  Measure the V_{OUT} value, as indicated below, and calculate the value of the CMRR using the equation shown.
  When V_{IN} = 0.0 V, V_{IN} = $V_{IN}1$ and V_{OUT} = $V_{OUT}1$
  When V_{IN} = 2.5 V, V_{IN} = $V_{IN}2$ and V_{OUT} = $V_{OUT}2$

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

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

3. V_{OH}

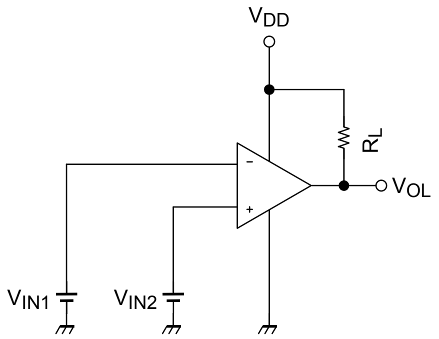


- V_{OH}

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

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

4. V_{OL}

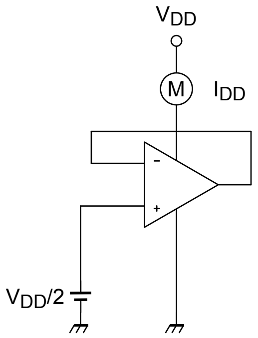


- V_{OL}

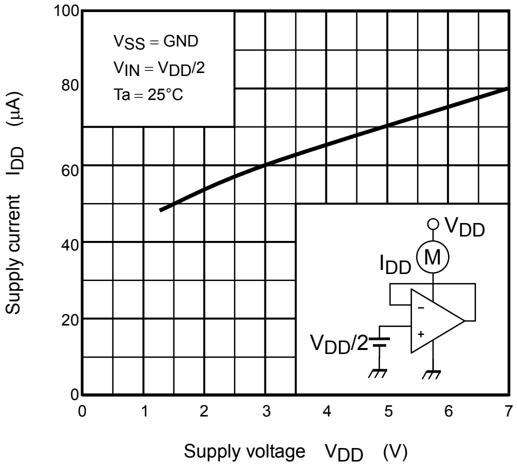
$$V_{IN1} = \frac{V_{DD}}{2} + 0.05\ V$$

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

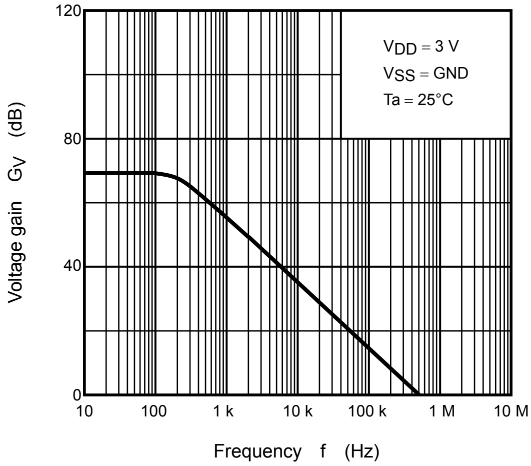
5. I_{DD}



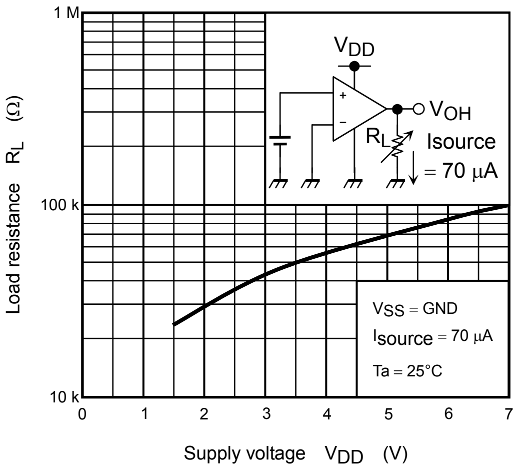
$I_{DD} – V_{DD}$



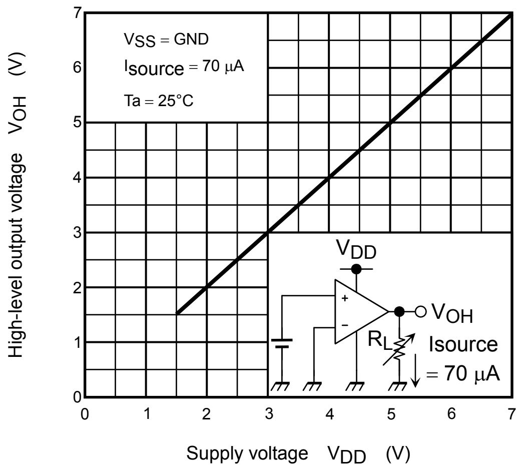
$G_V – f$

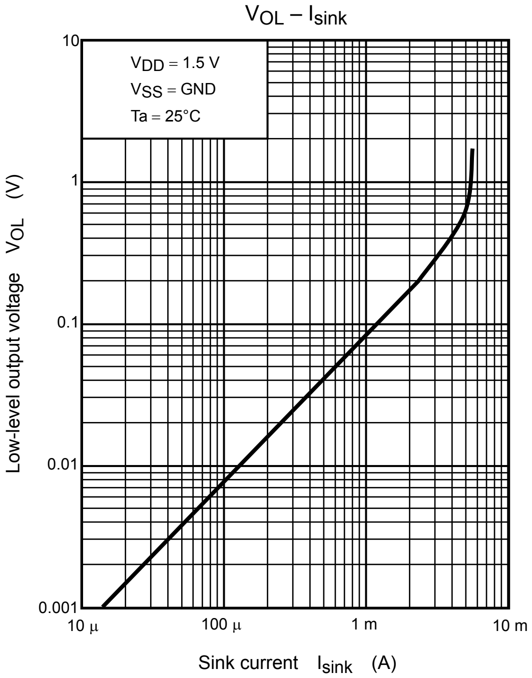


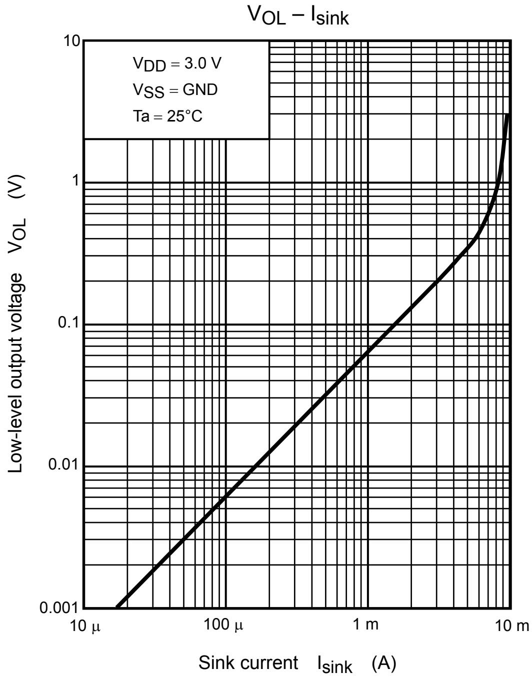
$R_L – V_{DD}$

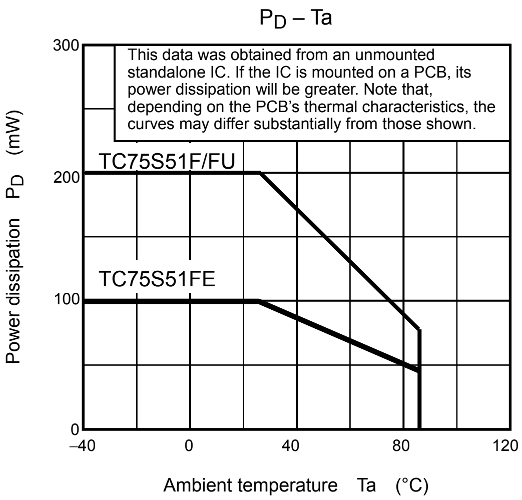


$V_{OH} – V_{DD}$

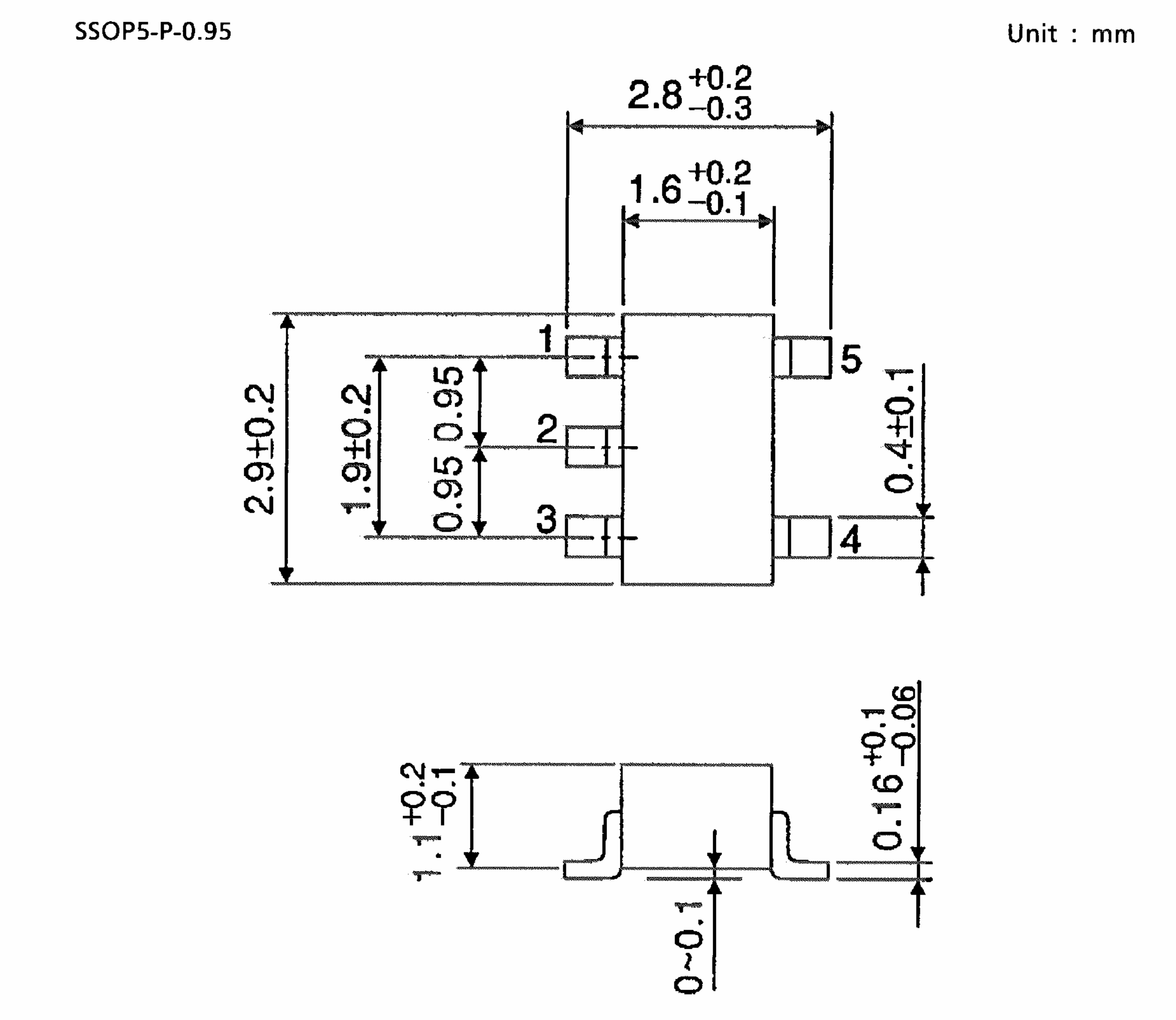



VOL – Isink
VDD = 1.5 V
VSS = GND
Ta = 25°C
Low-level output voltage VOL (V)
10
1
0.1
0.01
0.001
10 μ
100 μ
1 m
10 m
Sink current Isink (A)


VOL – Isink
VDD = 3.0 V
VSS = GND
Ta = 25°C
Low-level output voltage VOL (V)
10
1
0.1
0.01
0.001
10 μ
100 μ
1 m
10 m
Sink current Isink (A)


PD – Ta
This data was obtained from an unmounted standalone IC. If the IC is mounted on a PCB, its power dissipation will be greater. Note that, depending on the PCB's thermal characteristics, the curves may differ substantially from those shown.
TC75S51F/FU
TC75S51FE
Power dissipation PD (mW)
300
200
100
0
–40
0
40
80
120
Ambient temperature Ta (°C)

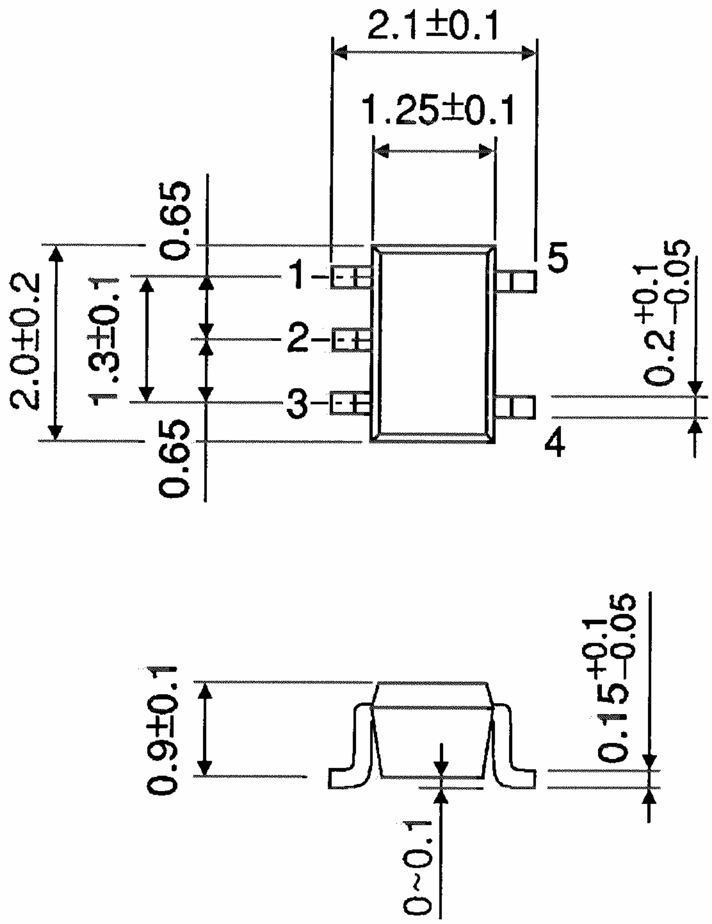
Package Dimensions



Weight: 0.014 g (typ.)

Package Dimensions

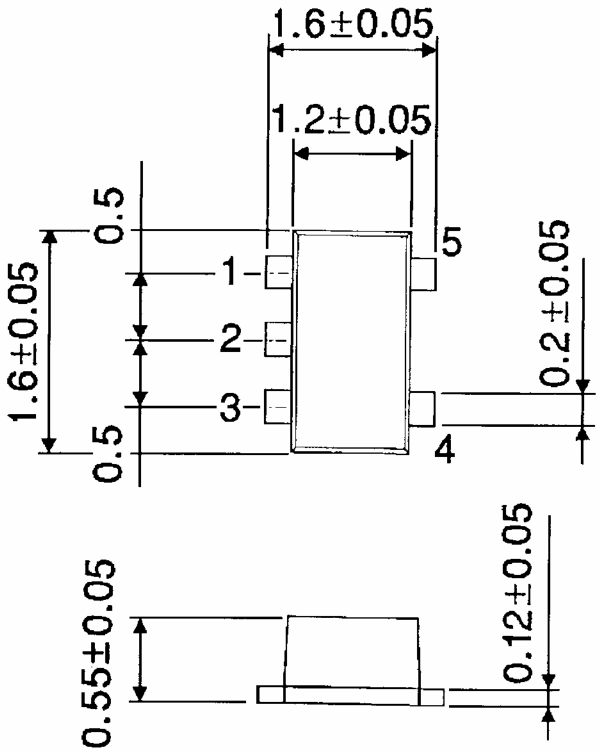
SSOP5-P-0.65A Unit : mm



Weight: 0.006 g (typ.)

Package Dimensions

SON5-P-0.50 Unit : mm



Weight: 0.003 g (typ.)

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