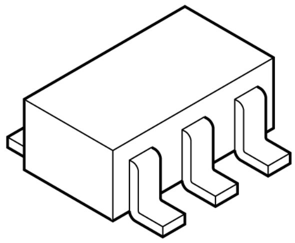
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TC75S55F,TC75S55FU,TC75S55FE

Single Operational Amplifier

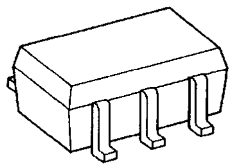
The TC75S55F/TC75S55FU/TC75S55FE is a CMOS single-operation amplifier which incorporates a phase compensation circuit. It is designed for use with a low-voltage, low-current power supply; this differentiates this device from conventional general-purpose bipolar op-amps.

TC75S55F



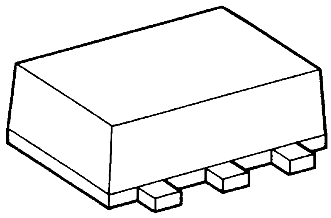
SSOP5-P-0.95

TC75S55FU



SSOP5-P-0.65A

TC75S55FE



SON5-P-0.50

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

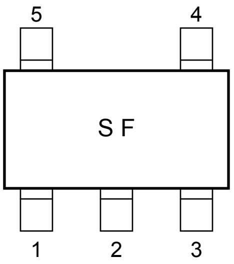
- Low-voltage operation : V_{DD} = ±0.9~3.5 V or 1.8~7 V
- Low-current power supply : I_{DD} (V_{DD} = 3 V) = 10 μA (typ.)
- Built-in phase-compensated op-amp, obviating the need for any external device
- Ultra-compact package

Absolute Maximum Ratings (Ta = 25°C)

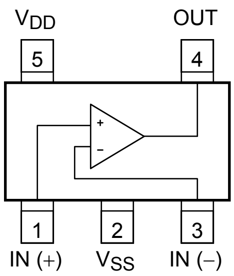
Characteristics		Symbol	Rating	Unit
Supply voltage		V_{DD}, V_{SS}	7	V
Differential input voltage		DV_{IN}	±7	V
Input voltage		V_{IN}	V_{DD}~V_{SS}	V
Power dissipation	TC75S55F/FU	P_D	200	mW
	TC75S55FE		100	
Operating temperature		T_{opr}	−40~85	°C
Storage temperature		T_{stg}	−55~125	°C

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 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	—	2	10	mV
Input offset current	I_{IO}	—	—	—	1	—	pA
Input bias current	I_I	—	—	—	1	—	pA
Common mode input voltage	CMV_{IN}	2	—	0.0	—	2.1	V
Voltage gain (open loop)	G_V	—	—	60	70	—	dB
Maximum output voltage	V_{OH}	3	R_L ≧ 1 MΩ	2.9	—	—	V
	V_{OL}	4	R_L ≧ 1 MΩ	—	—	0.1	
Common mode input signal Rejection Ratio	CMRR	2	V_{IN} = 0.0~2.1 V	60	70	—	dB
Supply voltage rejection ratio	SVRR	1	V_{DD} = 1.8~7.0 V	60	70	—	dB
Supply current	I_{DD}	5	—	—	10	20	μA
Source current	I_{source}	6	—	10	20	—	μA
Sink current	I_{sink}	7	—	100	450	—	μA

DC Characteristics (V_{DD} = 1.8 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 = 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	—	0.0	—	0.9	V
Voltage gain (open loop)	G_V	—	—	60	70	—	dB
Maximum output voltage	V_{OH}	3	R_L ≧ 1 MΩ	1.7	—	—	V
	V_{OL}	4	R_L ≧ 1 MΩ	—	—	0.1	
Supply current	I_{DD}	5	—	—	8	16	μA
Source current	I_{source}	6	—	8	16	—	μA
Sink current	I_{sink}	7	—	100	400	—	μA

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

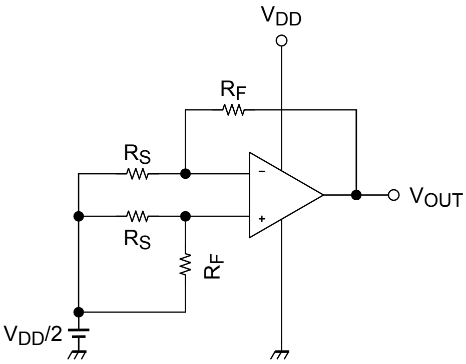
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Slew rate	SR	—	—	—	0.08	—	V/μs
Unity gain cross frequency	f_T	—	—	—	160	—	kHz

AC Characteristics (V_{DD} = 1.8 V, V_{SS} = GND, Ta = 25°C)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Slew rate	SR	—	—	—	0.06	—	V/μs
Unity gain cross frequency	f_T	—	—	—	140	—	kHz

Test Circuit

1. SVRR, V_{IO}



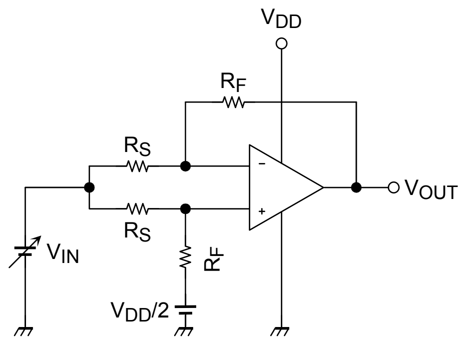
- SVRR
  For each of the two V_{DD} values, measure the V_{OUT} value, as indicated below, and calculate the value of SVRR using the equation shown.
  When V_{DD} = 1.8 V, V_{DD} = $V_{DD}1$ and V_{OUT} = $V_{OUT}1$
  When V_{DD} = 7.0 V, V_{DD} = $V_{DD}2$ and V_{OUT} = $V_{OUT}2$

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

- V_{IO}
  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}

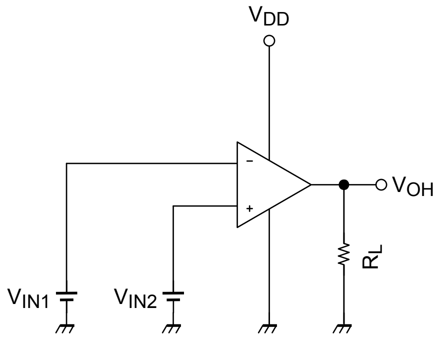


- CMRR
  Measure the V_{OUT} value, as indicated below, and calculate the value of the CMRR using the equation shown.
  When V_{IN} = 0.0 V, V_{IN} = $V_{IN}1$ and V_{OUT} = $V_{OUT}1$
  When V_{IN} = 2.1 V, V_{IN} = $V_{IN}2$ and V_{OUT} = $V_{OUT}2$

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

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

3. V_{OH}

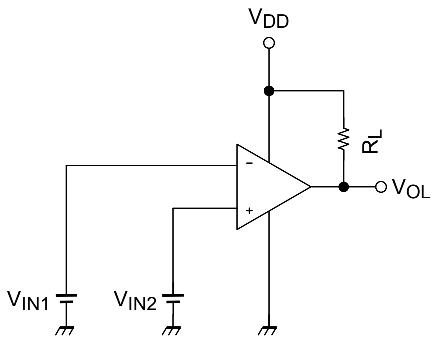


- V_{OH}

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

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

4. V_{OL}

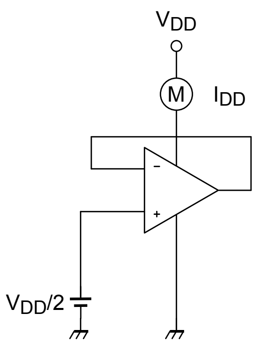


- V_{OL}

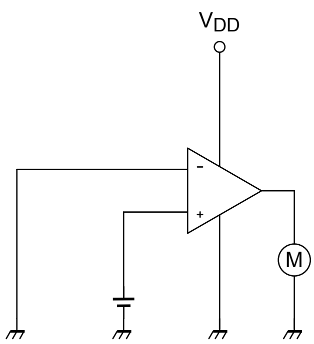
$$V_{IN1} = \frac{V_{DD}}{2} + 0.05\ \mathrm{V}$$

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

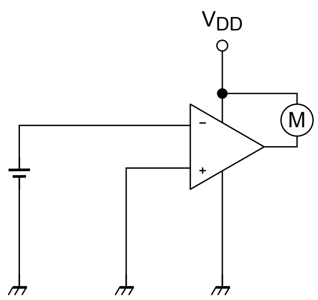
5. I_{DD}

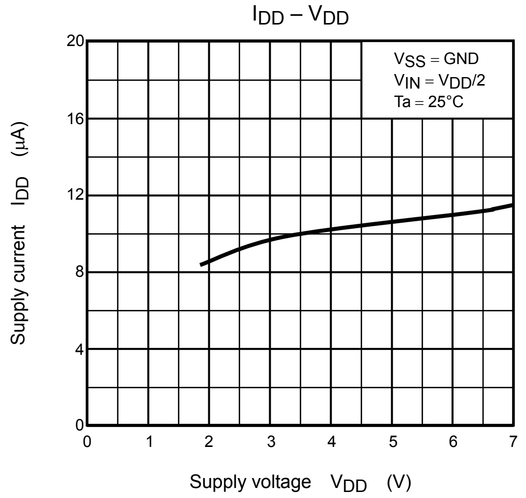


6. I_{source}

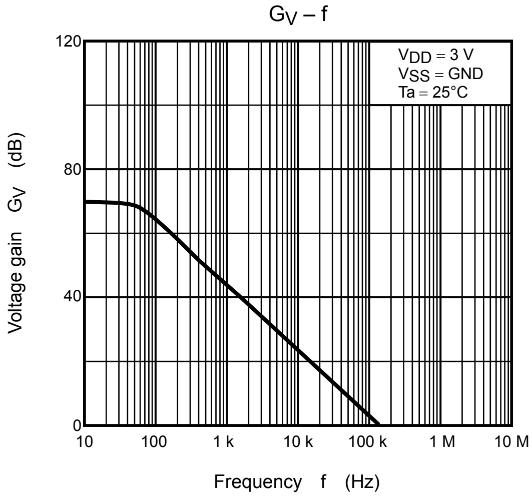


7. I_{sink}

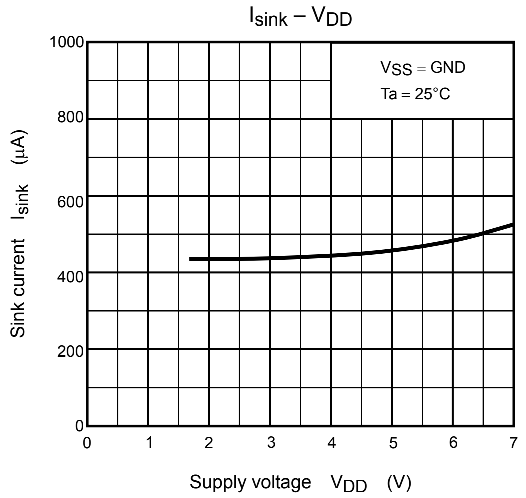




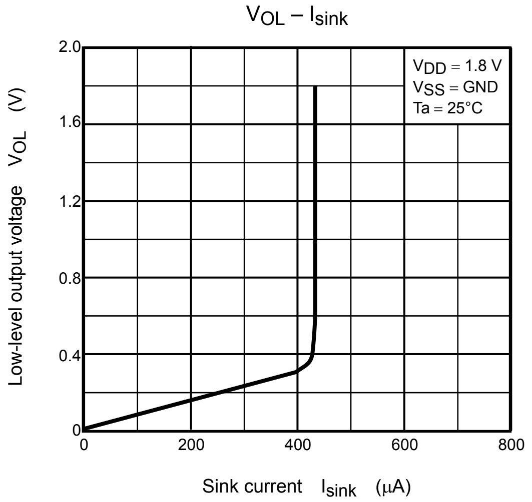
I_{DD} – V_{DD}
V_{SS} = GND
V_{IN} = V_{DD}/2
Ta = 25°C
Supply current I_{DD} (μA)
Supply voltage V_{DD} (V)



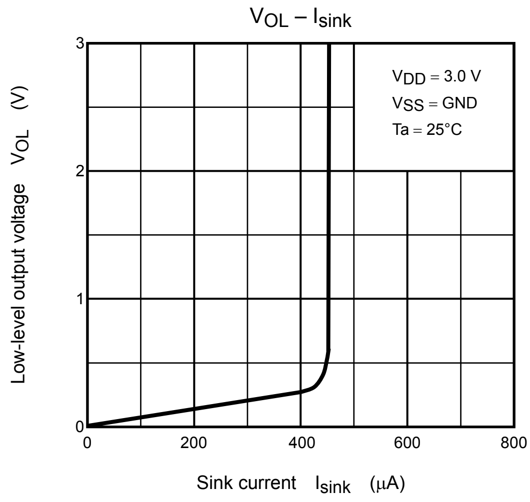
G_V – f
V_{DD} = 3 V
V_{SS} = GND
Ta = 25°C
Voltage gain G_V (dB)
Frequency f (Hz)



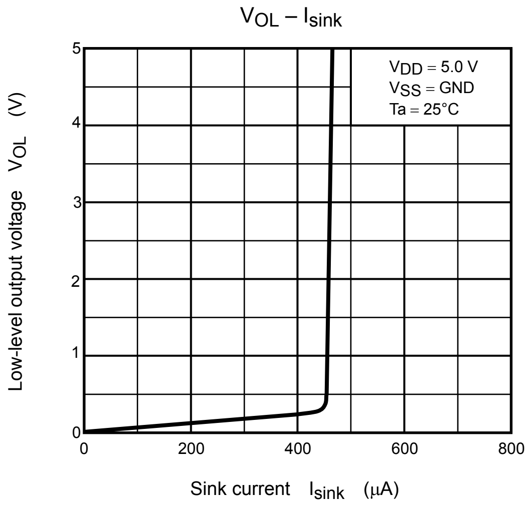
I_{sink} – V_{DD}
V_{SS} = GND
Ta = 25°C
Sink current I_{sink} (μA)
Supply voltage V_{DD} (V)



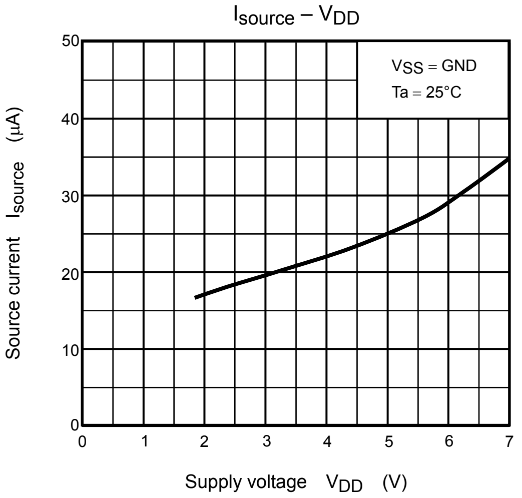
V_{OL} – I_{sink}
V_{DD} = 1.8 V
V_{SS} = GND
Ta = 25°C
Low-level output voltage V_{OL} (V)
Sink current I_{sink} (μA)

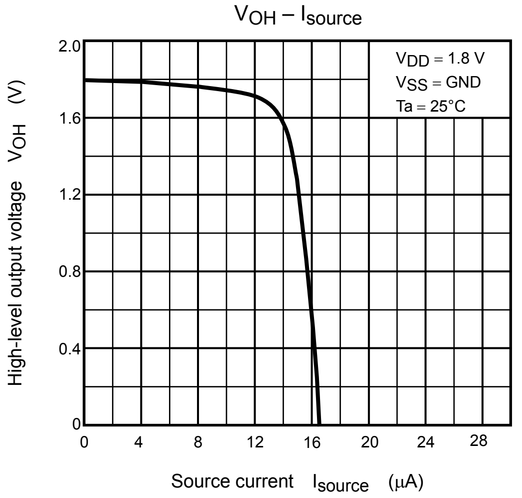


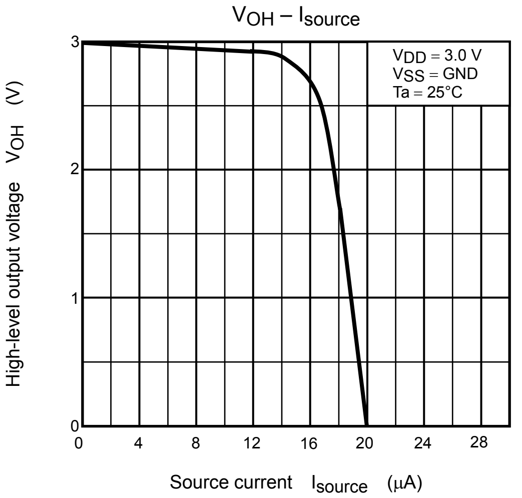
V_{OL} – I_{sink}
V_{DD} = 3.0 V
V_{SS} = GND
Ta = 25°C
Low-level output voltage V_{OL} (V)
Sink current I_{sink} (μA)

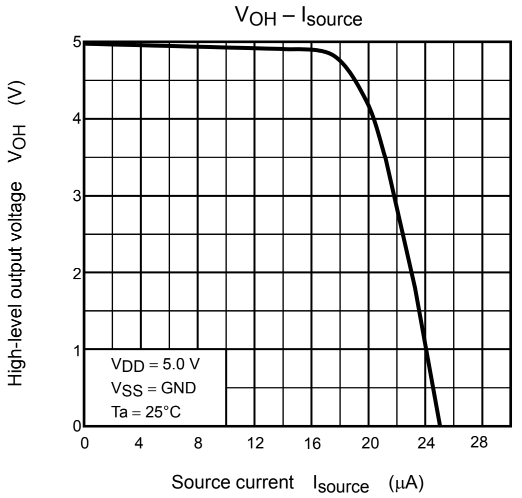


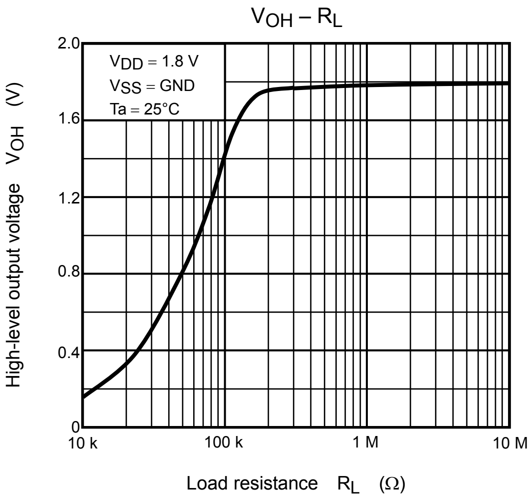
V_{OL} – I_{sink}
V_{DD} = 5.0 V
V_{SS} = GND
Ta = 25°C
Low-level output voltage V_{OL} (V)
Sink current I_{sink} (μA)

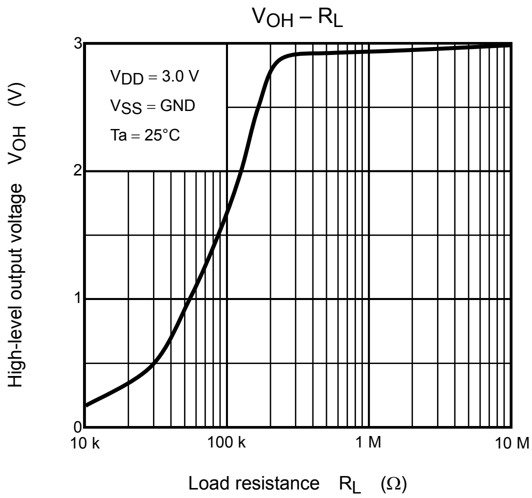

I_{source} – V_{DD}
V_{SS} = GND
Ta = 25°C
Source current I_{source} (μA)
Supply voltage V_{DD} (V)
0
10
20
30
40
50
0
1
2
3
4
5
6
7

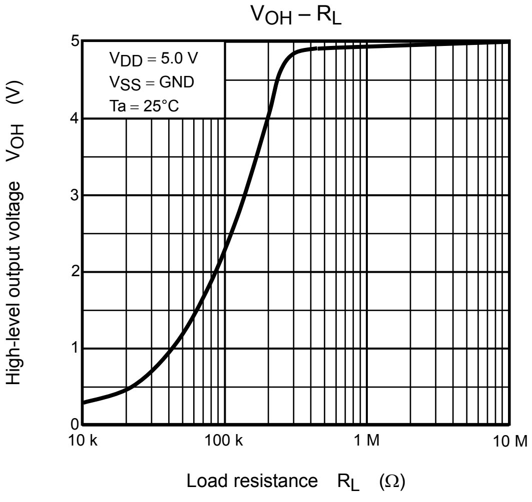

V_{OH} – I_{source}
V_{DD} = 1.8 V
V_{SS} = GND
Ta = 25°C
High-level output voltage V_{OH} (V)
Source current I_{source} (μA)
0
0.4
0.8
1.2
1.6
2.0
0
4
8
12
16
20
24
28

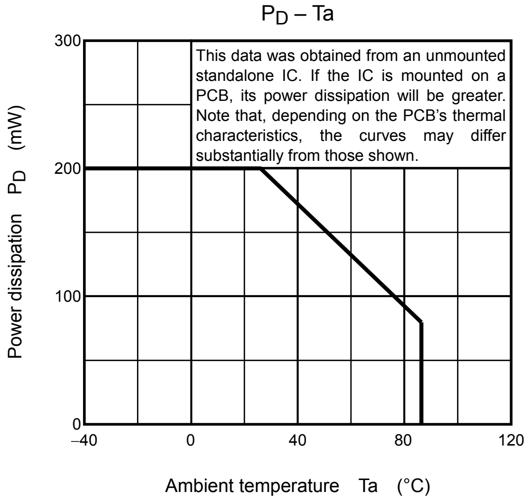

V_{OH} – I_{source}
V_{DD} = 3.0 V
V_{SS} = GND
Ta = 25°C
High-level output voltage V_{OH} (V)
Source current I_{source} (μA)
0
1
2
3
0
4
8
12
16
20
24
28


V_{OH} – I_{source}
V_{DD} = 5.0 V
V_{SS} = GND
Ta = 25°C
High-level output voltage V_{OH} (V)
Source current I_{source} (μA)
0
1
2
3
4
5
0
4
8
12
16
20
24
28

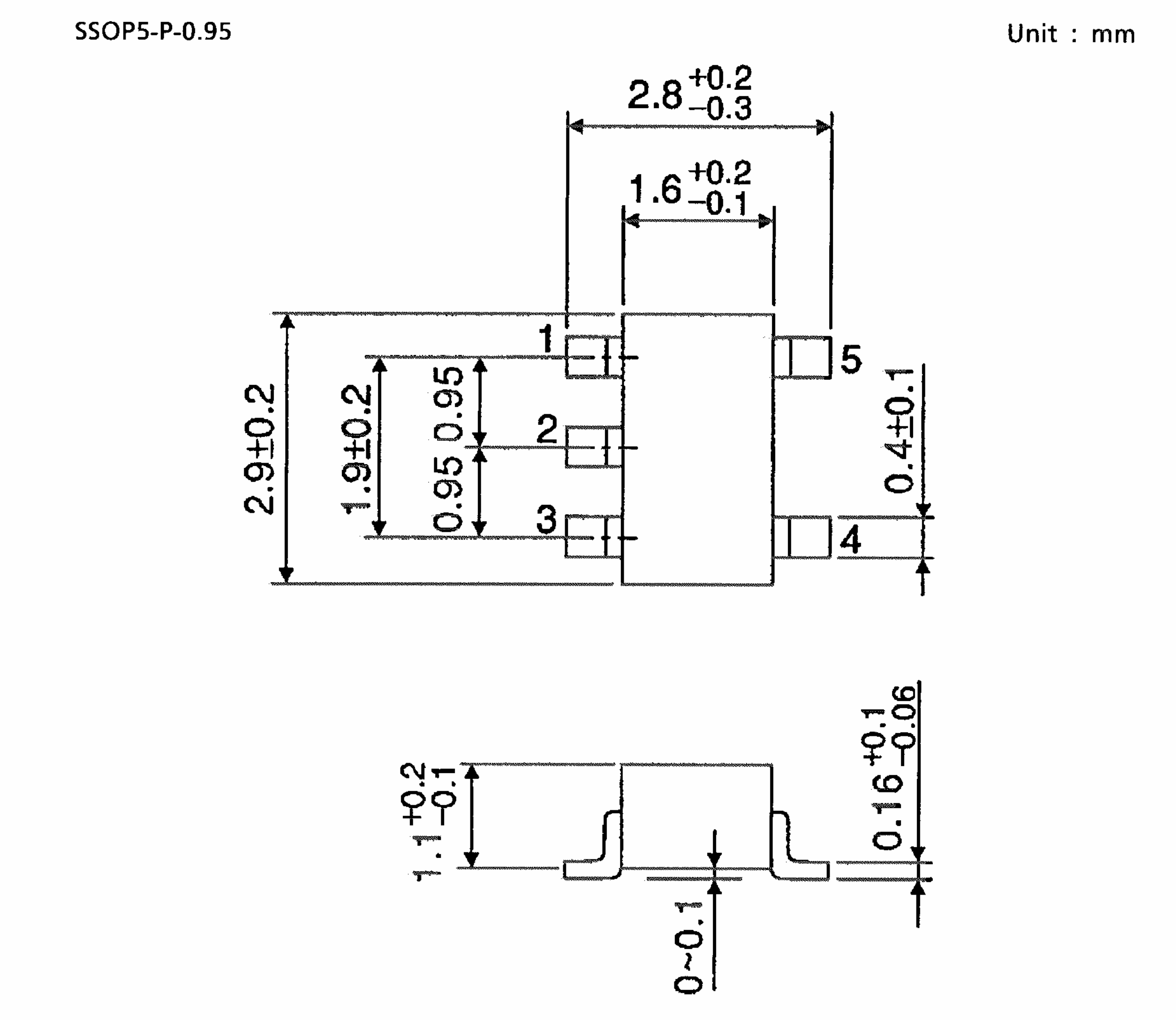

V_{OH} – R_L
V_{DD} = 1.8 V
V_{SS} = GND
Ta = 25°C
High-level output voltage V_{OH} (V)
Load resistance R_L (Ω)
0
0.4
0.8
1.2
1.6
2.0
10 k
100 k
1 M
10 M


V_{OH} – R_L
V_{DD} = 3.0 V
V_{SS} = GND
Ta = 25°C
High-level output voltage V_{OH} (V)
Load resistance R_L (Ω)
0
1
2
3
10 k
100 k
1 M
10 M


VOH – RL
VDD = 5.0 V
VSS = GND
Ta = 25°C
High-level output voltage VOH (V)
0
1
2
3
4
5
10 k
100 k
1 M
10 M
Load resistance RL (Ω)

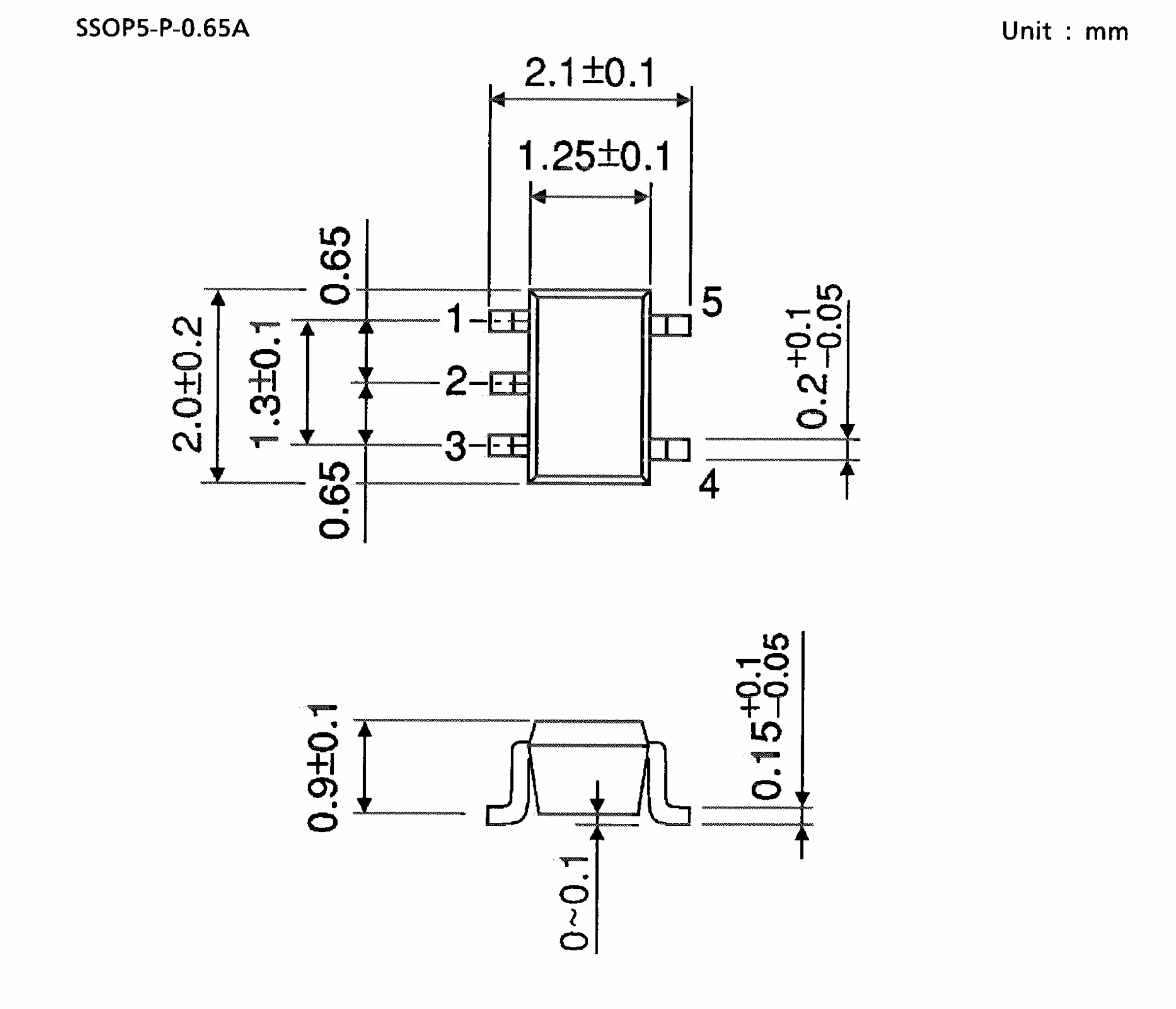

PD – Ta
This data was obtained from an unmounted standalone IC. If the IC is mounted on a PCB, its power dissipation will be greater. Note that, depending on the PCB's thermal characteristics, the curves may differ substantially from those shown.
Power dissipation PD (mW)
0
100
200
300
–40
0
40
80
120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

Package Dimensions



Weight: 0.014 g (typ.)

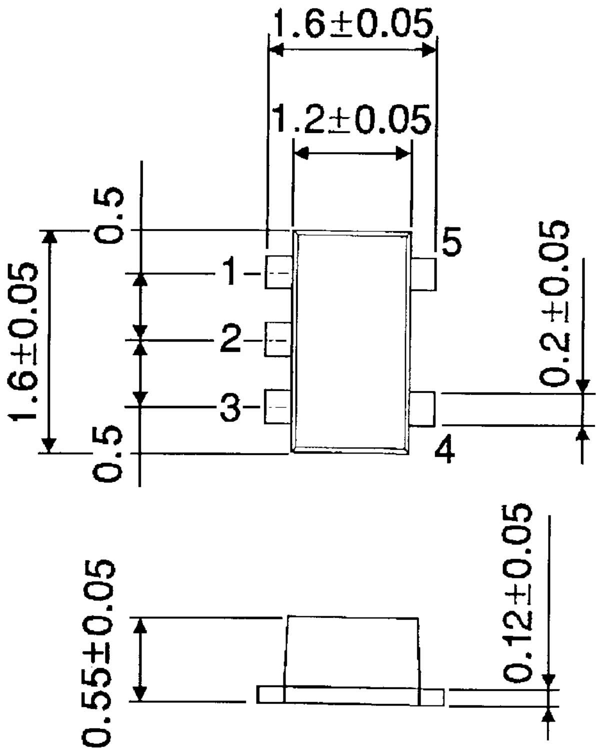
Package Dimensions



Weight: 0.006 g (typ.)

Package Dimensions

SON5-P-0.50 Unit : mm



Weight: 0.003 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.