

TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

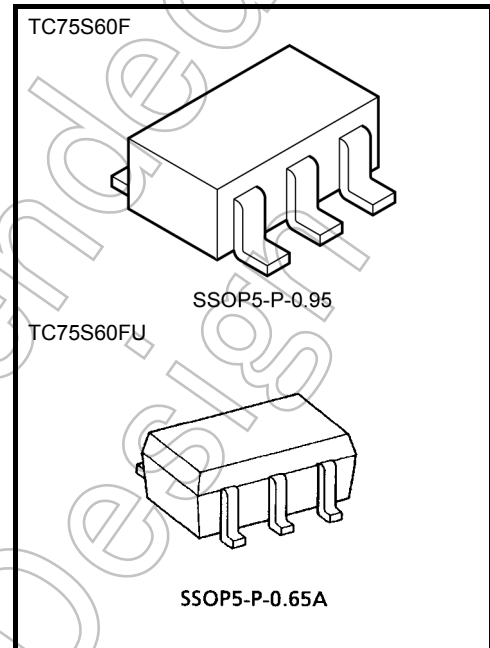
TC75S60F, TC75S60FU

Single Operational Amplifier

TC75S60F, TC75S60FU are CMOS operational amplifier with low supply voltage, low supply current.

Features

- High slew rate: $SR (V_{DD} = 3 V) = 5.1 V/\mu s$ (typ.)
- The power supply operation range is:
 $V_{DD} = \pm 0.9$ to $3.5 V$ or 1.8 to $7 V$
- Low supply current: $I_{DD} (V_{DD} = 3 V) = 330 \mu A$ (typ.)
- The internally phase compensated operational amplifier.
- Small package



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

Absolute Maximum Ratings (Ta = 25°C)

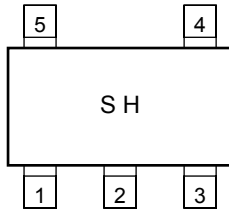
| Characteristics | Symbol | Rating | Unit |
|----------------------------|------------------|----------------------|------|
| Supply voltage | V_{DD}, V_{SS} | 7 | V |
| Differential input voltage | DV_{IN} | ± 7 | V |
| Input voltage | V_{IN} | V_{DD} to V_{SS} | V |
| Power dissipation | P_D | 200 | mW |
| 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.

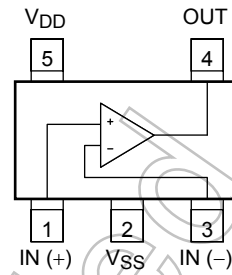
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Start of commercial production
2000-09

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 | $R_S = 1\text{ k}\Omega$ | — | 2 | 7 | 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 | $R_L = 100\text{ k}\Omega$ | 2.9 | — | — | V |
| | V_{OL} | 4 | $R_L = 100\text{ k}\Omega$ | — | — | 0.1 | |
| Common mode rejection ratio | CMRR | 2 | $V_{IN} = 0.0\text{ to }2.1\text{ V}$ | 54 | 70 | — | dB |
| Supply voltage rejection ratio | SVRR | 1 | $V_{DD} = 1.8\text{ to }7.0\text{ V}$ | 60 | 70 | — | dB |
| Supply current | I_{DD} | 5 | — | — | 330 | 500 | μA |
| Source current | I_{source} | 6 | — | 330 | 700 | — | μA |
| Sink current | I_{sink} | 7 | — | 600 | 1250 | — | μA |

DC Characteristics ($V_{DD} = 1.8\text{ V}$, $V_{SS} = \text{GND}$, $T_a = 25^\circ\text{C}$)

| Characteristics | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|-----------------------------|--------------|--------------|---------------------------------------|-----|------|-----|---------------|
| Input offset voltage | V_{IO} | 1 | $R_S = 10\text{ k}\Omega$ | — | 2 | 7 | mV |
| Input offset current | I_{IO} | — | — | — | 1 | — | pA |
| Input bias current | I_I | — | — | — | 1 | — | pA |
| Common mode input voltage | CMV_{IN} | 2 | — | 0.3 | — | 0.9 | V |
| Voltage gain (open loop) | G_V | — | — | — | 70 | — | dB |
| maximum output voltage | V_{OH} | 3 | $R_L = 100\text{ k}\Omega$ | 1.7 | — | — | V |
| | V_{OL} | 4 | $R_L = 100\text{ k}\Omega$ | — | — | 0.1 | |
| Common mode rejection ratio | CMRR | 2 | $V_{IN} = 0.3\text{ to }0.9\text{ V}$ | 50 | 60 | — | dB |
| Supply current | I_{DD} | 5 | — | — | 300 | 450 | μA |
| Source current | I_{source} | 6 | — | 300 | 600 | — | μA |
| Sink current | I_{sink} | 7 | — | 550 | 1150 | — | μA |

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

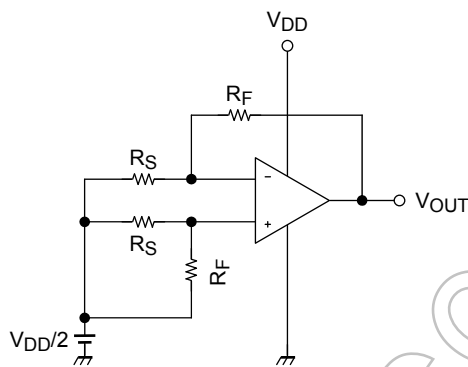
| Characteristics | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|----------------------------|--------|--------------|----------------|-----|------|-----|------------------|
| Slew rate | SR | — | — | — | 5.1 | — | V/ μs |
| Unity gain cross frequency | f_T | — | — | — | 3.7 | — | MHz |

AC Characteristics ($V_{DD} = 1.8\text{ V}$, $V_{SS} = \text{GND}$, $T_a = 25^\circ\text{C}$)

| Characteristics | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|----------------------------|--------|--------------|----------------|-----|------|-----|------------------|
| Slew rate | SR | — | — | — | 4.0 | — | V/ μs |
| Unity gain cross frequency | f_T | — | — | — | 3.0 | — | MHz |

Test Circuit

1. SVRR, V_{IO}



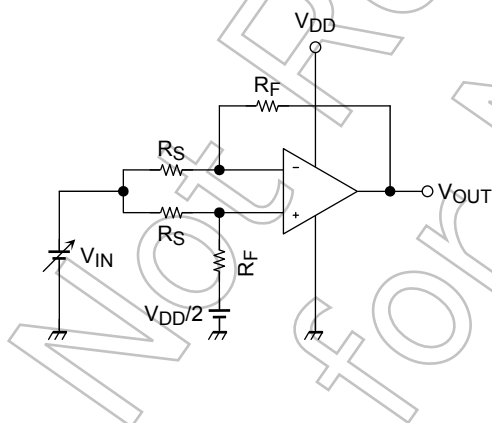
- SVRR
 $V_{DD} = 1.8\text{ V}: V_{DD} = V_{DD1}, V_{OUT} = V_{OUT1}$
 $V_{DD} = 7.0\text{ V}: V_{DD} = V_{DD2}, V_{OUT} = V_{OUT2}$

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

- V_{IO}

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

2. CMRR, CMV_{IN}

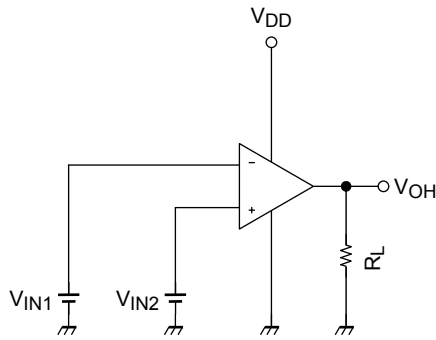


- CMRR
 $V_{IN} = 0.0\text{ V}: V_{IN} = V_{IN1}, V_{OUT} = V_{OUT1}$
 $V_{IN} = 2.1\text{ V}: V_{IN} = V_{IN2}, V_{OUT} = V_{OUT2}$

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

- CMV_{IN}

3. V_{OH}

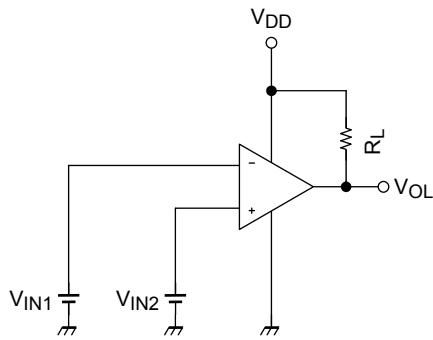


- V_{OH}

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

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

4. V_{OL}

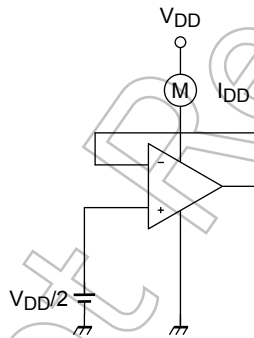


- V_{OL}

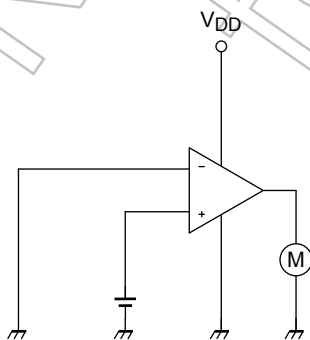
$$V_{IN1} = \frac{V_{DD}}{2} + 0.05 \text{ V}$$

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

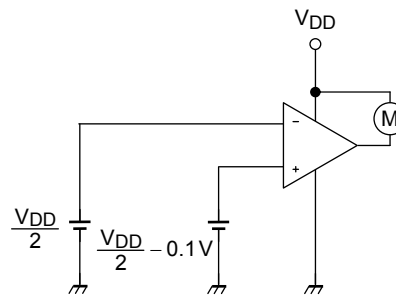
5. I_{DD}

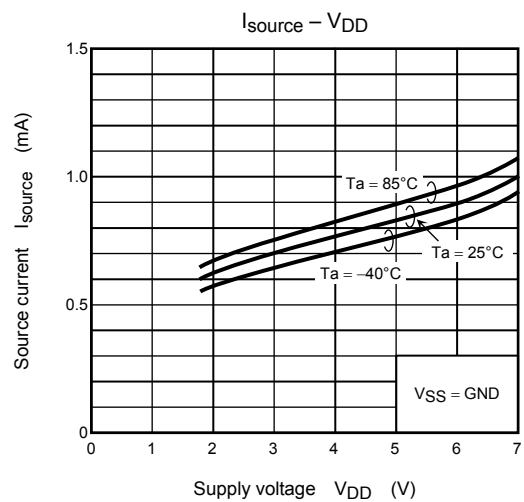
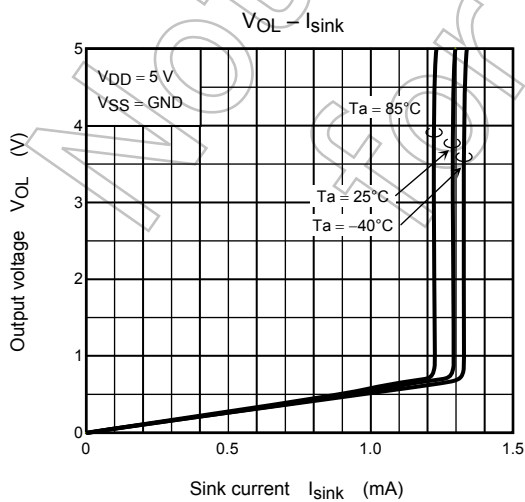
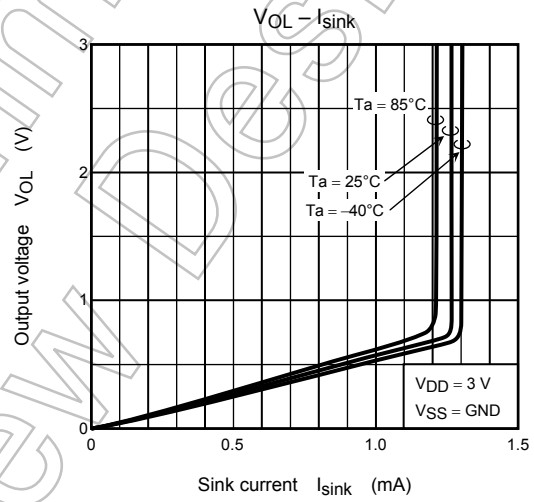
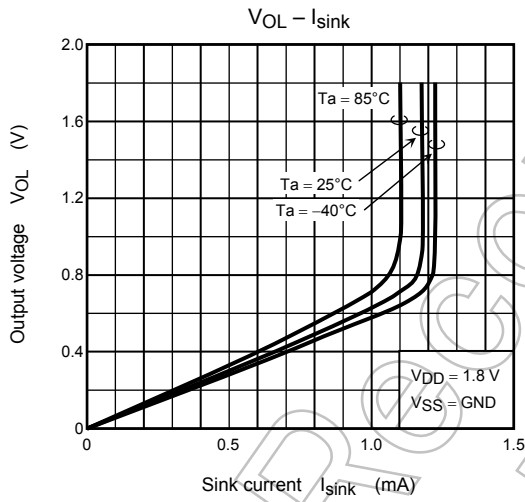
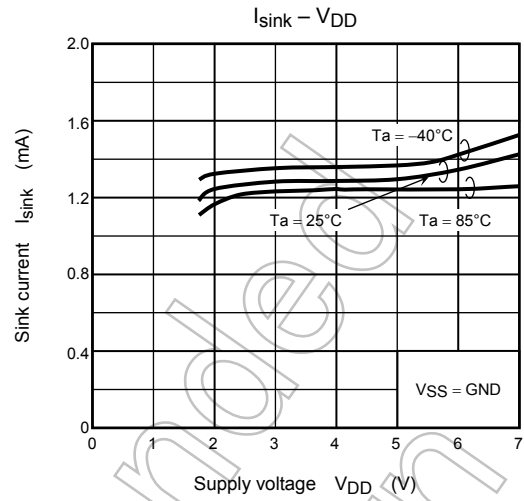
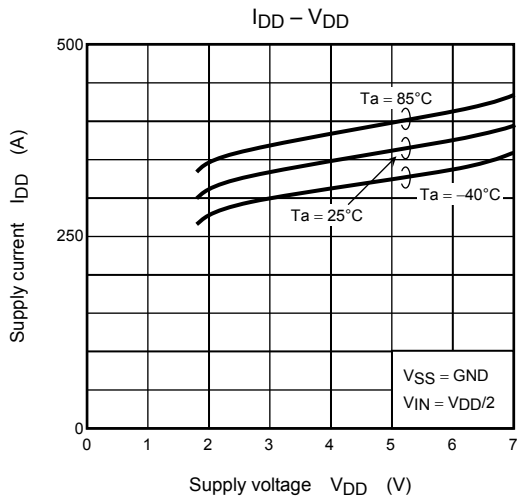


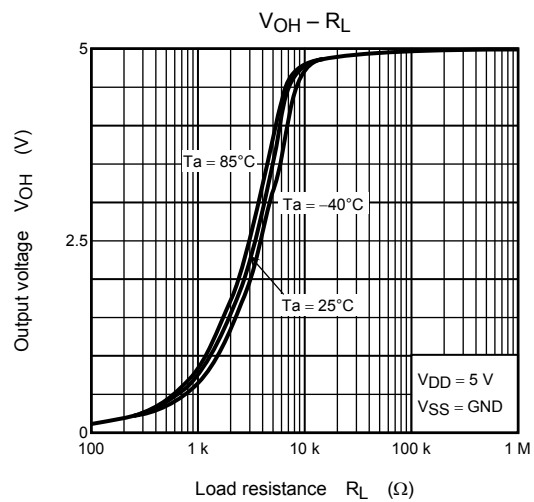
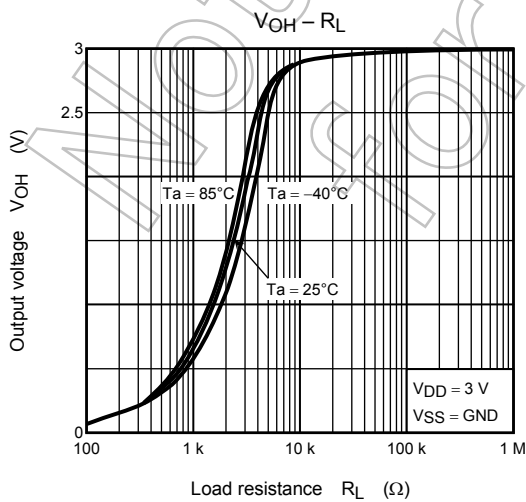
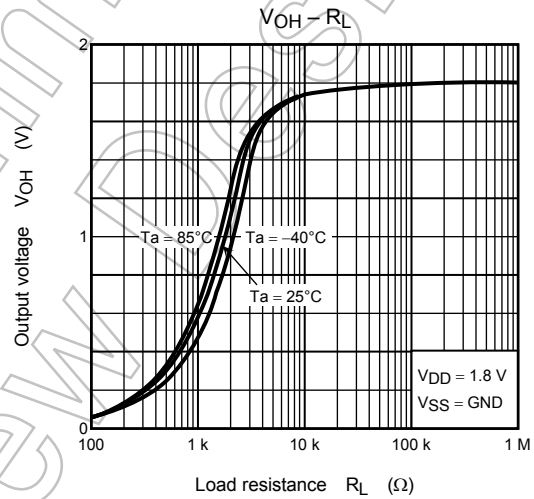
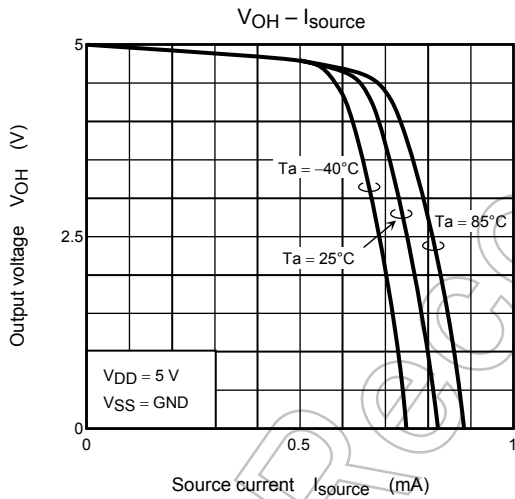
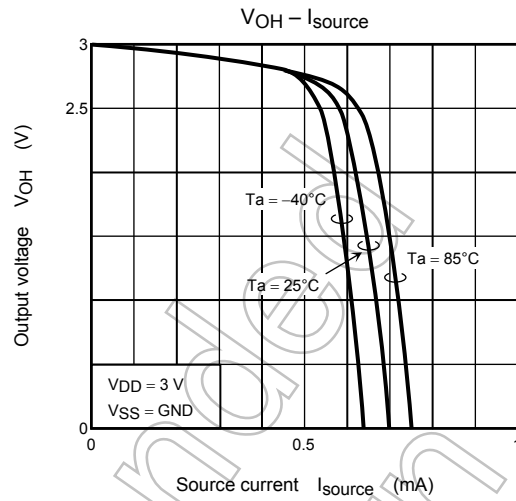
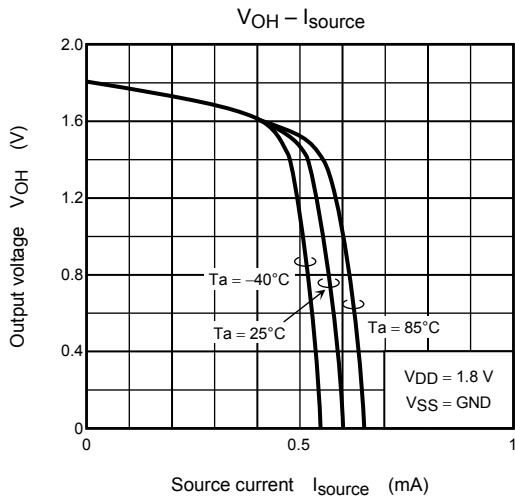
6. I_{source}

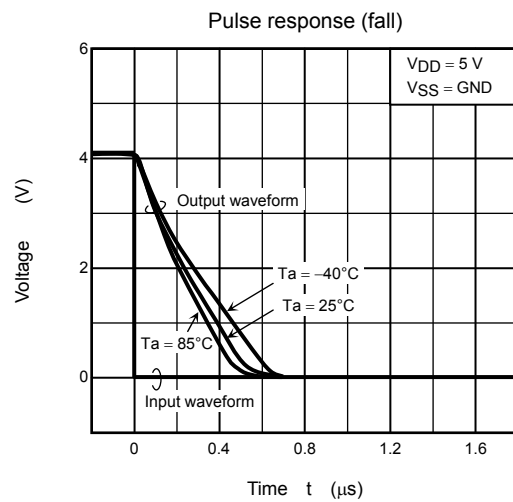
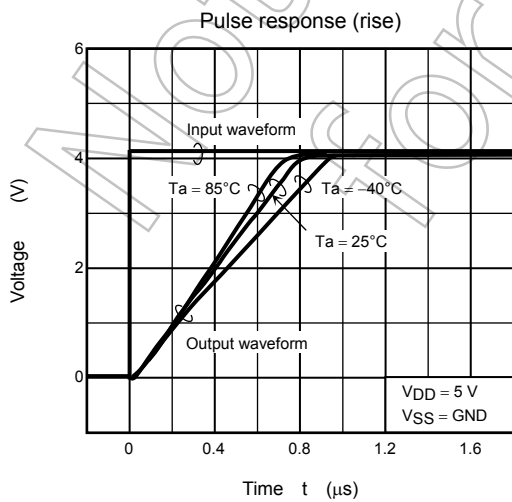
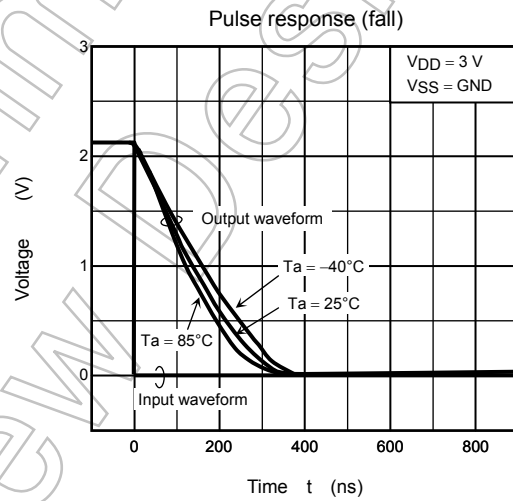
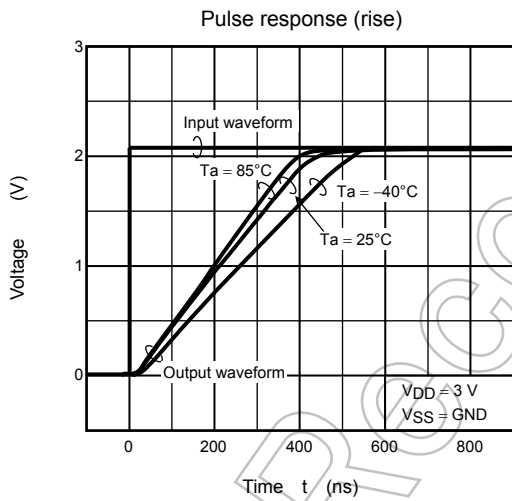
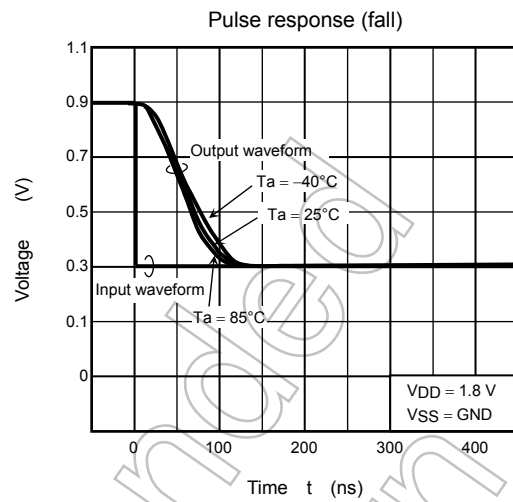
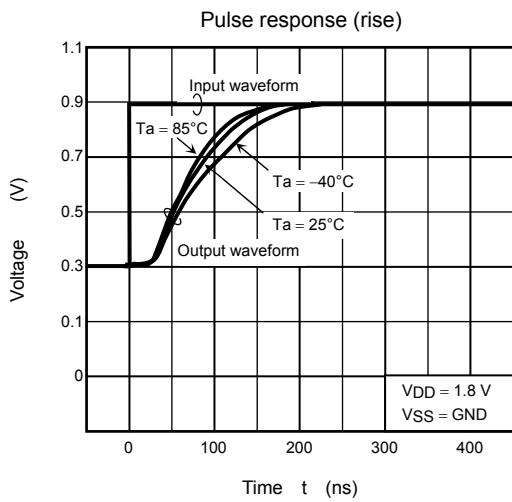


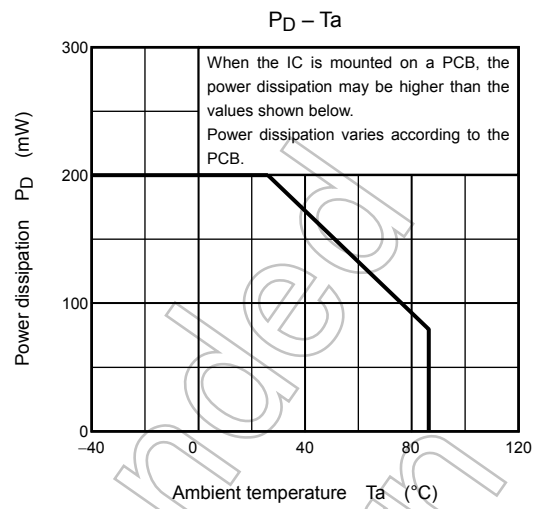
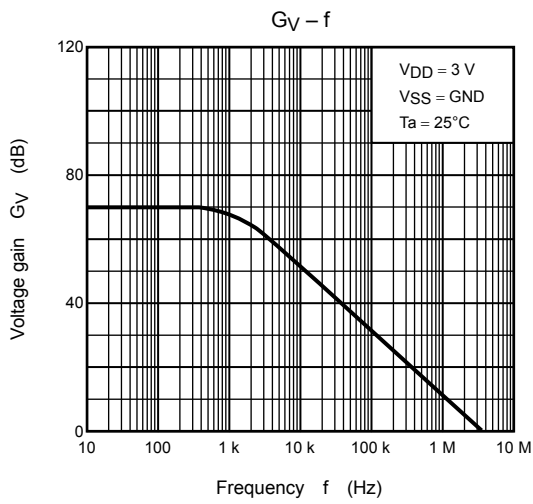
7. I_{sink}









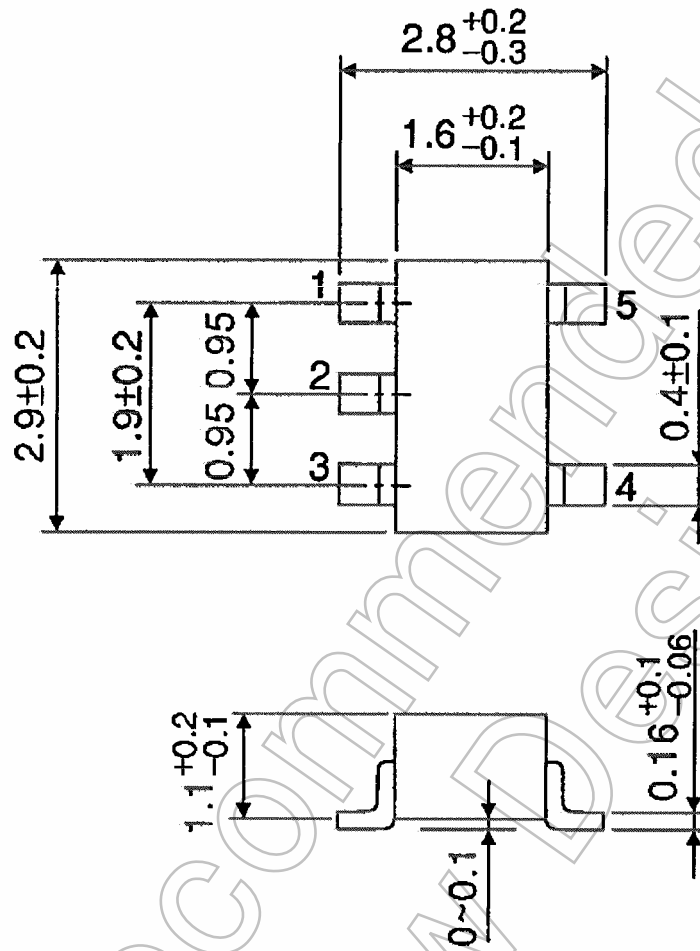


Not Recommended for New Design

Package Dimensions

SSOP5-P-0.95

Unit : mm



Weight: 0.014 g (typ.)

Not Recommended for New Design

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