TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

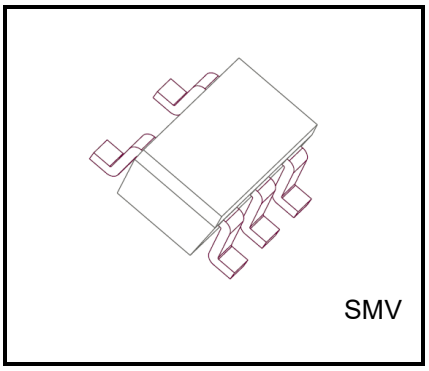
TC75S102F

Single Operational Amplifier

Ultra-Low supply current

Features

- Input and Output Full Range
- Ultra-Low supply current 0.27μA (Typ.) @V_{DD}=1.5V
- Low Input offset voltage 1.3mV (Max) @V_{DD}=1.5V
- Wide Operating Voltage Range 1.5V to 5.5V



SMV

Weight:
SMV (SOT-25)(SC-74A) :14 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{DD} - V_{SS}	6	V
Differential input voltage	DV_{IN}	±6	V
Input voltage	V_{IN}	V_{DD} to V_{SS}	V
Output voltage	V_{OUT}	V_{SS} -0.3V to V_{DD} +0.3V ≤ V_{SS} + 6V	V
Output current	I_{OUT}	±25	mA
Power dissipation	P_D	200	mW
Operating temperature	T_{opr}	-40 to 105	°C
Storage temperature	T_{stg}	-55 to 150	°C

Note1: 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).

Operating Ratings (Ta = -40 to 105°C)

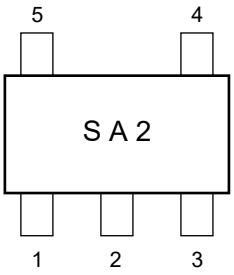
Characteristics	Symbol	Rating	Unit
Supply voltage	V_{DD} - V_{SS}	1.5 to 5.5	V

Note2: A higher load capacitance will increase the risk of voltage oscillation. Allow sufficient capacitance value when designing your circuit and using this product to prevent voltage oscillation.

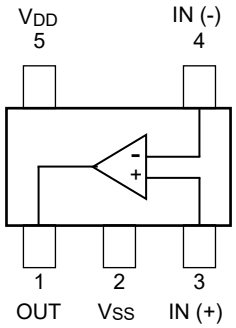
Note3: This device is sensitive to electrostatic discharge.
Please ensure equipment, operator and tools are adequately earthed when handling.

Start of commercial production
2020-06

Marking (top view)



Pin Assignment (top view)



Electrical Characteristics

DC Characteristics (V_{DD} = 1.5V, V_{SS} = GND, Ta = 25°C, V_{IN} = V_{DD}/2, unless otherwise noted.)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input offset voltage	V_{IO}	1	R_S = 1 kΩ, R_F = 100kΩ	-1.3	-0.1	1.3	mV
Input offset voltage drift	V_{IO}drift	1	R_S = 1 kΩ, R_F = 100kΩ	-	2.8	-	μV/°C
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 = 100kΩ	0	-	V_{DD}	V
Voltage gain (open loop)	G_V	-	-	64	139	-	dB
Maximum output voltage	V_{OH}	3	R_L ≥ 100 kΩ	1.4	-	-	V
	V_{OL}	4	R_L ≥ 100 kΩ	-	-	0.1	
Common mode input signal rejection ratio	CMRR	2	V_{IN} = 0 to 1.5V	53	80	-	dB
Supply voltage rejection ratio	SVRR	1	V_{DD} = 1.5 to 5.0V	61	80	-	dB
Supply current	I_{DD}	5	Ta = -40 to 105°C	-	0.27	0.60	μA
			Ta = 25°C	-	0.27	0.46	μA
Source current	I_{source}	6	-	0.34	0.6	-	mA
Sink current	I_{sink}	7	-	0.28	0.4	-	mA

AC Characteristics (V_{DD} = 0.75 V, V_{SS} = -0.75 V, Ta = 25°C)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Unity Gain Cross Frequency	f_T	-	-	-	0.5	-	kHz
Phase margin	Φm	-	-	-	53	-	degrees
Slew Rate	SR	-	-	-	0.37	-	V/ms

DC Characteristics (V_{DD} = 5.0V, V_{SS} = GND, Ta = 25°C, V_{IN}=V_{DD}/2, unless otherwise noted.)

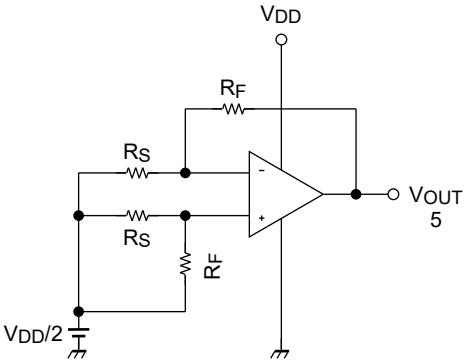
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input offset voltage	V_{IO}	1	R_S = 1 kΩ, R_F = 100 kΩ	-1.7	-0.1	1.7	mV
Input offset voltage drift	V_{IO}drift	1	R_S = 1 kΩ, R_F = 100 kΩ	-	2.4	-	μV/°C
Input offset current	I_{IO}	-	-	-	1	-	pA
Input bias current	I_I	-	-	-	1	-	pA
Common mode input voltage	CMV_{IN}	2	R_S = 1 kΩ, R_F = 100 kΩ	0	-	V_{DD}	V
Voltage gain (open loop)	G_V	-	-	80	100	-	dB
Maximum output voltage	V_{OH}	3	$R_L \geq$ 100 kΩ	4.9	-	-	V
	V_{OL}	4	$R_L \geq$ 100 kΩ	-	-	0.1	
Common mode input signal rejection ratio	CMRR	2	V_{IN} = 0 to 5.0V	59	80	-	dB
Supply current	I_{DD}	5	Ta = -40 to 105°C	-	0.35	0.7	μA
			Ta = 25°C	-	0.35	0.54	μA
Source current	I_{source}	6	-	7.8	11	-	mA
Sink current	I_{sink}	7	-	8.2	10	-	mA

AC Characteristics (V_{DD} = 2.5 V, V_{SS} = -2.5 V, Ta = 25°C)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Unity Gain Cross Frequency	f_T	-	-	-	0.63	-	kHz
Phase margin	Φm	-	-	-	63	-	degrees
Slew Rate	SR	-	-	-	0.45	-	V/ms

Test Circuit

1. SVRR, V_{IO}



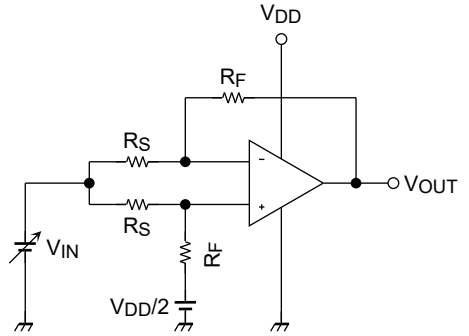
- SVRR
- For each of the two V_{DD} values, measure the V_{OUT} value, as indicated below, and calculate the value of SVRR using the equation shown.
  When V_{DD} = 1.5 V, V_{DD} = V_{DD1} and V_{OUT} = V_{OUT1}
  When V_{DD} = 5.0 V, V_{DD} = V_{DD2} and V_{OUT} = V_{OUT2}

$$SVRR=20\log\left[\left|\frac{V_{DD1}-V_{DD2}}{\left\{V_{OUT1}-\left(\frac{V_{DD1}}{2}\right)\right\}-\left\{V_{OUT2}-\left(\frac{V_{DD2}}{2}\right)\right\}}\right|\times\frac{R_F+R_S}{R_S}\right]$$

- 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}

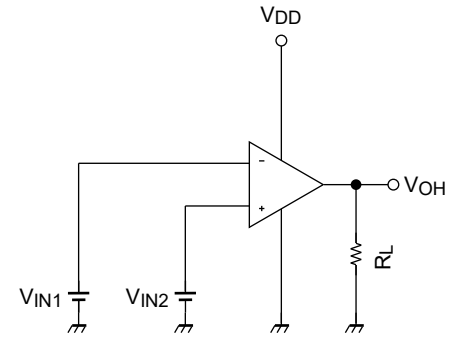


- CMRR
  Measure the V_{OUT} value, as indicated below, and calculate the value of the CMRR using the equation shown.
  When V_{IN} = 0 V, V_{IN} = V_{IN1} and V_{OUT} = V_{OUT1}
  When V_{IN} = 5.0 V, V_{IN} = V_{IN2} and V_{OUT} = V_{OUT2}

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

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

3. V_{OH}

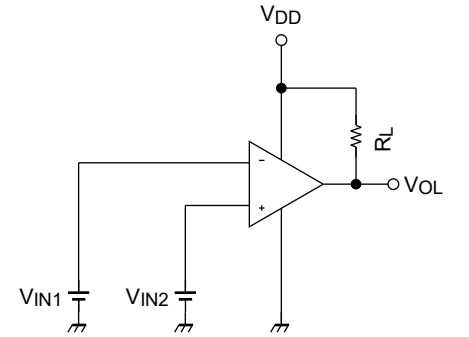


- V_{OH}

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

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

4. V_{OL}

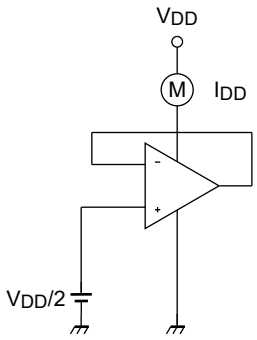


- V_{OL}

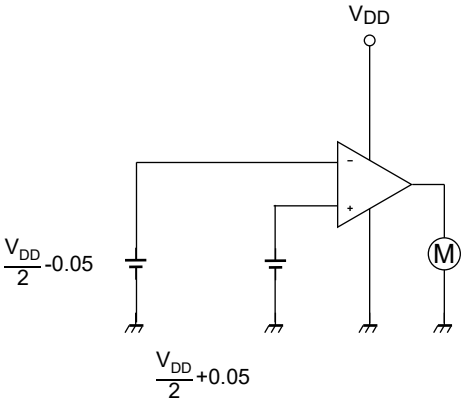
$$V_{IN1}=\frac{V_{DD}}{2}+0.05V$$

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

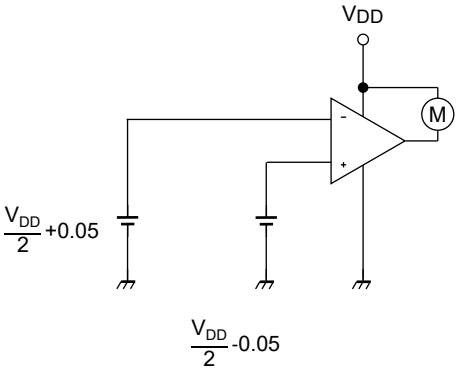
5. I_{DD}



6. I_{source}

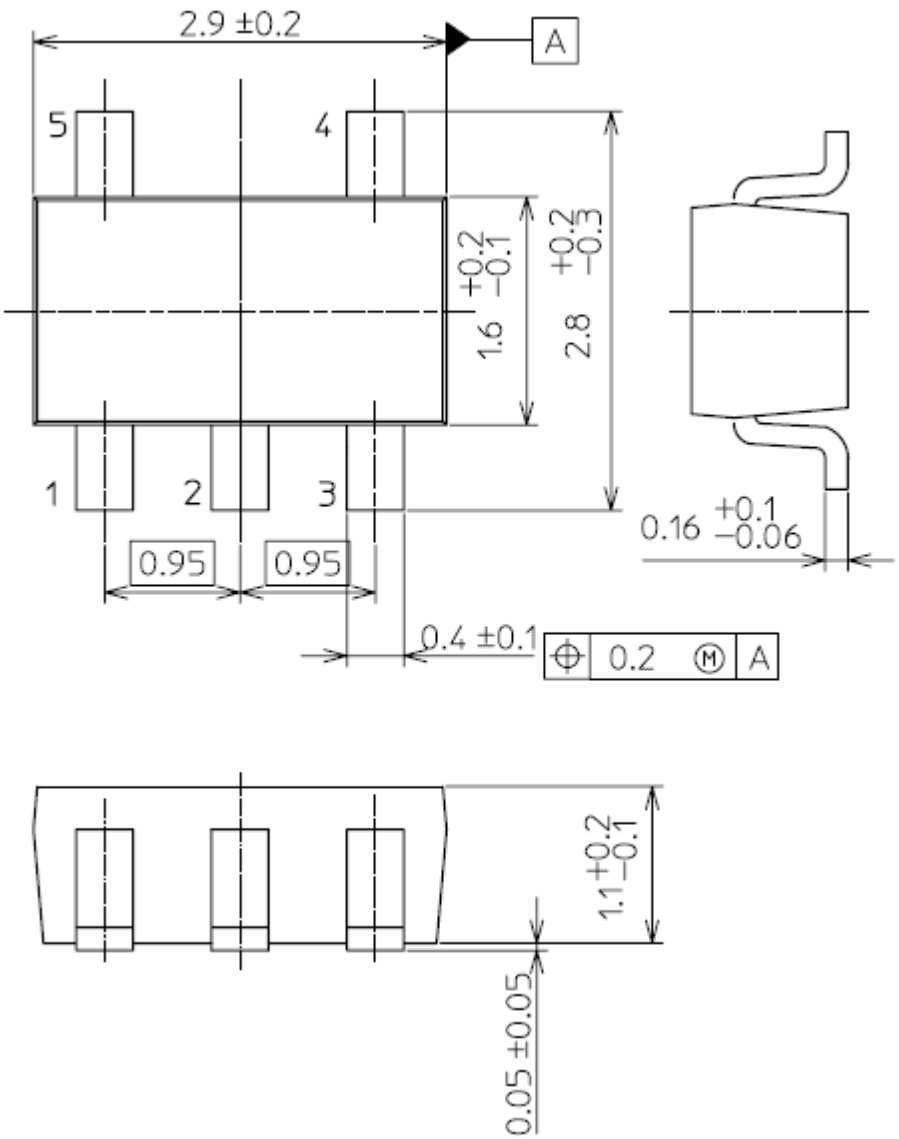


7. I_{sink}



Package Dimensions

SMV (SOT-25)(SC-74A) **Unit: mm**



Weight : 14 mg (typ.)

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