

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

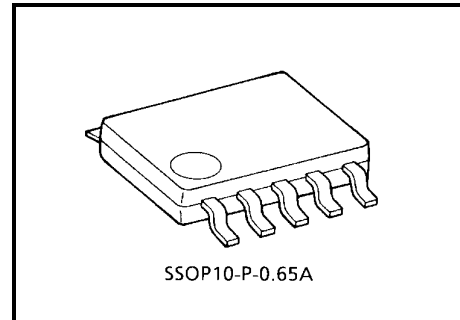
# TA6009FN, TA6009FNG

Shock Sensor IC (1 ch version)

TA6009FN/FNG detects an existence of external shock through the shock sensor and output.

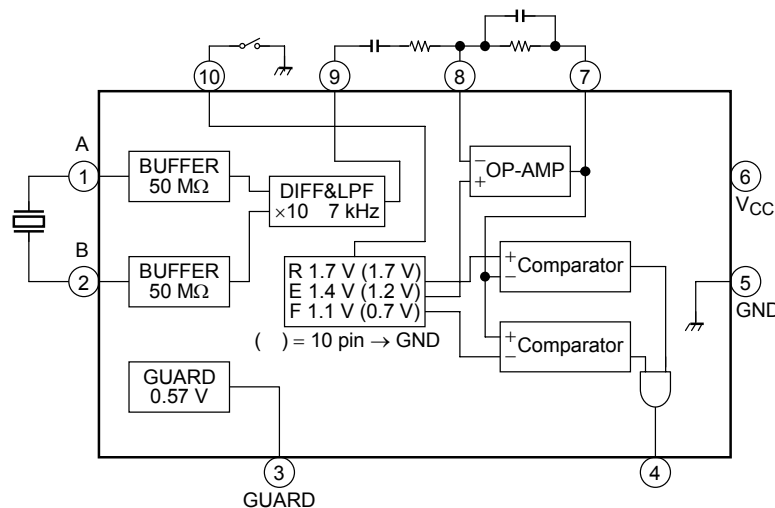
## Features

- TA6009FN/FNG operates from 2.7 to 5.5 V DC single power supply voltage.
- Signal from the shock sensor is amplified according to setting gain, and is detected through the internal window comparator.
- TA6009FN/FNG incorporates 1-ch shock detecting circuitry.
- Input terminal of sensor signal is designed high impedance.  
Differential input impedance = 100 MΩ (typ.)
- LPF (low pass filter) circuitry is incorporated.  
Cut-off frequency of LPF = 7 kHz
- Sensitivity of shock detection can be adjusted by external devices.
- Small package  
SSOP10-P-0.65A (0.65 mm pitch)

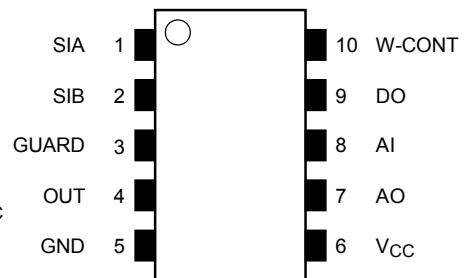


Weight: 0.04 g (typ.)

## Block Diagram



## Pin Connection (top view)



## Pin Function

Pin No.	Pin Name	Function
1	SIA	Connection terminal of shock sensor
2	SIB	Connection terminal of shock sensor
3	GUARD	Input (1, 2 pin) GUARD terminal
4	OUT	Output terminal (output = "L" when shock is detected.)
5	GND	Ground terminal
6	V <sub>CC</sub>	Power supply voltage
7	AO	Op-Amp output terminal
8	AI	Op-Amp input terminal
9	DO	Differential-Amp output terminal
10	W-CONT	WindComp. trip voltage selection terminal

## Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V <sub>CC</sub>	7	V
Power dissipation	P <sub>D</sub>	300	mW
Storage temperature	T <sub>stg</sub>	-55 to 150	°C

## Recommend Operating Condition

Characteristics	Symbol	Rating	Unit
Power supply voltage	V <sub>CC</sub>	2.7 to 5.5	V
Operating temperature	T <sub>opr</sub>	-25 to 85	°C

## Electrical Characteristics (unless otherwise specified, $V_{CC} = 3.3\text{ V}$ , $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply voltage	$V_{CC}$	—	—	2.7	3.3	5.5	V
Supply current	$I_{CC}$	(1)	$V_{CC} = 3.3\text{ V}$		1.8	2.4	mA
			$V_{CC} = 5.0\text{ V}$		1.8	2.4	

### (GUARD)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Output voltage	$V_{oGur}$	(2)	—	0.52	0.57	0.62	V

### (DIFF-AMP)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input impedance (Note 1)	$Z_{in}$	—	—	50	100		$M\Omega$
Gain	$G_{vBuf}$	(3)	—	19.6	20	20.4	dB
Output DC voltage	$V_{oBuf}$	(4)	Connect C = 100 pF between 1 pin and 2 pin	0.7	1	1.3	V
Low pass filter cut-off freq.	$f_c$	(5)	Frequency at -3dB point	5	7	10	kHz
Output source current	$I_{Bso}$	(6)	$V_{oh} = V_{CC} - 1\text{ V}$	400	800		$\mu\text{A}$
Output sink current	$I_{Bsi}$	(7)	$V_{ol} = 0.3\text{ V}$	75	130		$\mu\text{A}$

Note 1: Marked parameters are reference data.

### (OP-AMP)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Cut-off frequency (Note 1)	$f_T$	—	—	1.5	2		MHz
Openloop gain (Note 1)	$G_{vo}$	—	—	80	90		dB
Input voltage 1	$V_{in1}$	(8)	10 pin → OPEN (Note 2)	1.33	1.4	1.47	V
Input voltage 2	$V_{in2}$	(9)	10 pin → GND (Note 2)	1.14	1.2	1.26	V
Input current	$I_{in}$	(10)	—		25	50	nA
Offset voltage (Note 1)	$V_{off}$	—	—	-5	0	5	mV
Output source current	$I_{Aso}$	(11)	$V_{oh} = V_{CC} - 1\text{ V}$	300	800		$\mu\text{A}$
Output sink current	$I_{Asi}$	(12)	$V_{ol} = 0.3\text{ V}$	130	200		$\mu\text{A}$

Note 1: Marked parameters are reference data.

Note 2: 10 pin must be non-connected otherwise connected to GND.

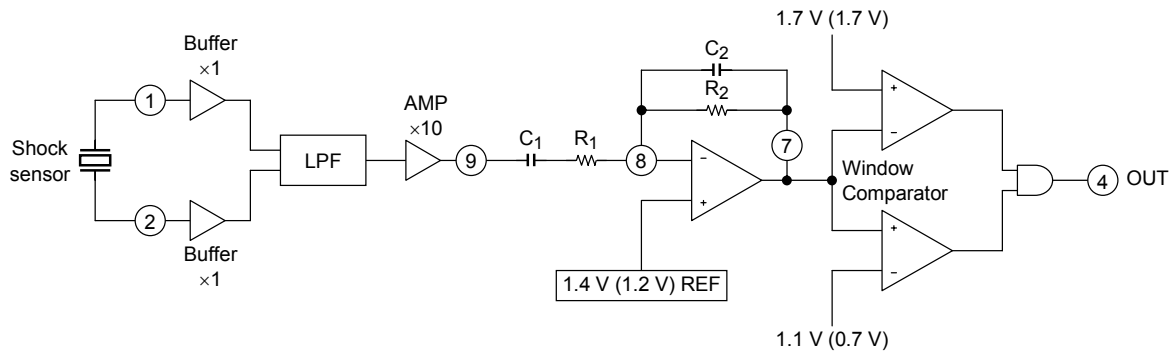
### (window-comparator)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Trip voltage 1 (Note 1)	$V_{trp1}$	—	10 pin → OPEN (Note 2)	$V_{in1} \pm 0.285$	$V_{in1} \pm 0.3$	$V_{in1} \pm 0.315$	V
Trip voltage 2 (Note 1)	$V_{trp2}$	—	10 pin → GND (Note 2)	$V_{in2} \pm 0.475$	$V_{in2} \pm 0.5$	$V_{in2} \pm 0.525$	V
Output source current	$I_{Wso}$	(13)	$V_{oh} = V_{CC} - 0.5\text{ V}$	30	50		$\mu\text{A}$
Output sink current	$I_{Wsi}$	(14)	$V_{ol} = 0.3\text{ V}$	300	800		$\mu\text{A}$

Note 1: Marked parameters are reference data.

Note 2: 10 pin must be non-connected otherwise connected to GND.

**Application Note**



**Figure 1 The Composition of G-Force Sense Amplifier**

Figure 1 is the composition of G-Force sense amplifier.

The shock sensor is connected between 1 and 2 terminal.

When G-force Sensor (sensor sensibility =  $s$  (mV/G)) is used to detect external shock of  $g$  (G), the external parts are determined as following.

(gain setting) \* 10 PIN → GND

$$500/(s \times g) = G1$$

$$G1/10 = G \text{ (OP-AMP)}$$

(HPF setting)

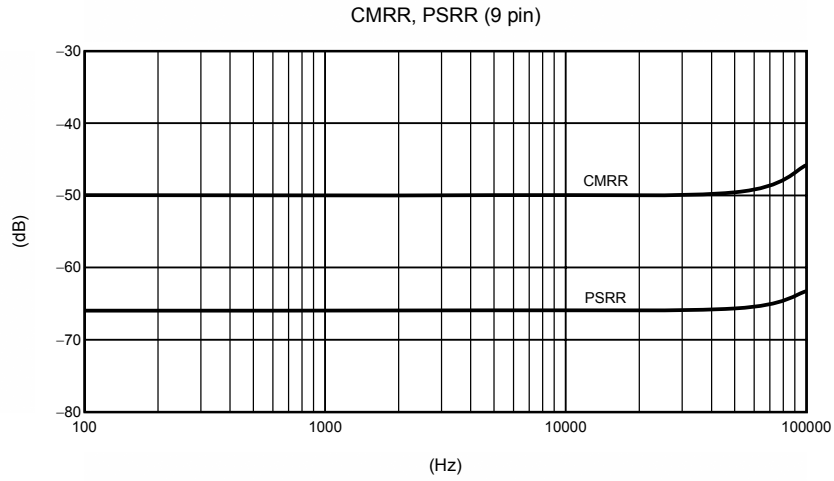
$$f_c = 1/(2 \pi \times R_1 \times C_1)$$

(LPF setting)

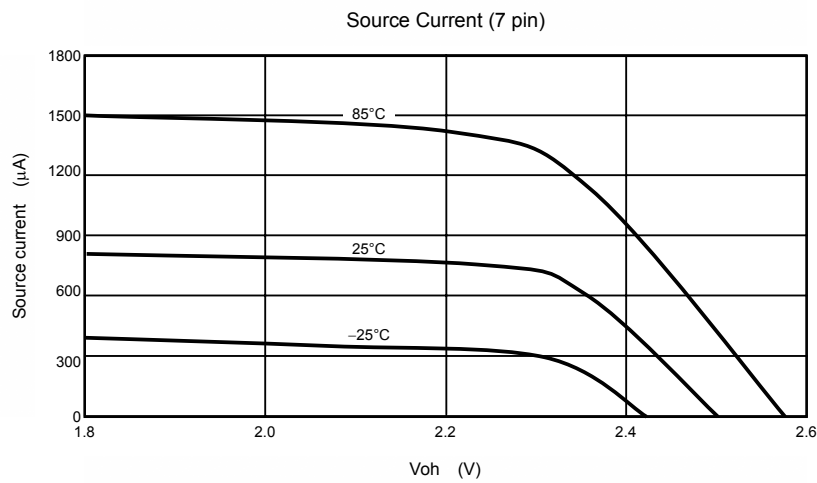
$$f_c = 1/(2 \pi \times R_2 \times C_2)$$

**Reference Data**

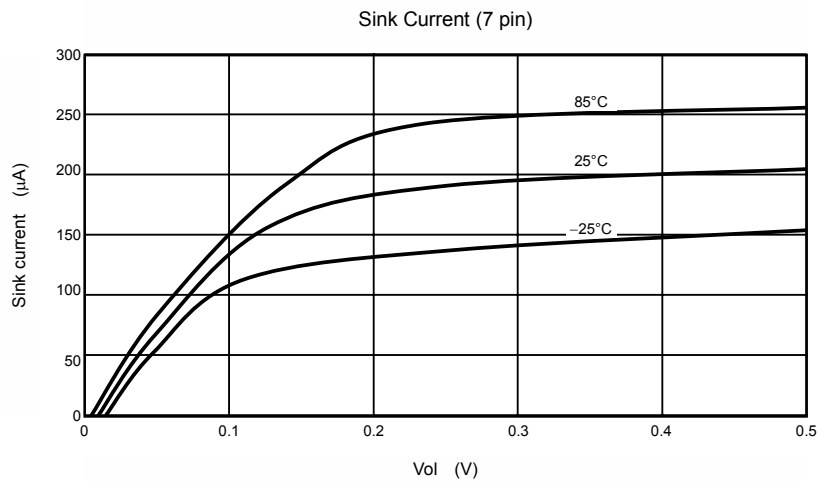
- (1) 9 pin (DIFF-AMP output) CMRR, PSRR



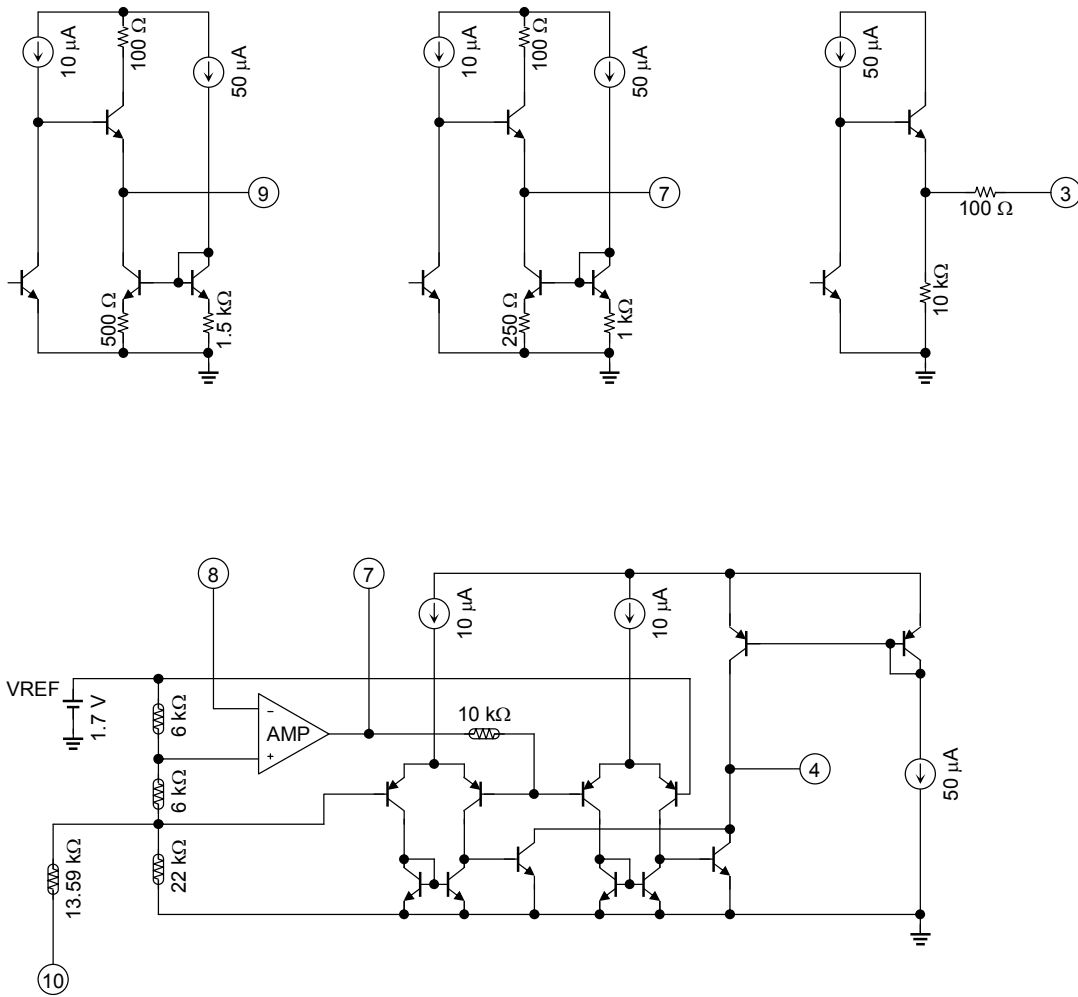
- (2) 7 pin (OP-AMP output) source current



- (3) 7 pin (OP-AMP output) sink current

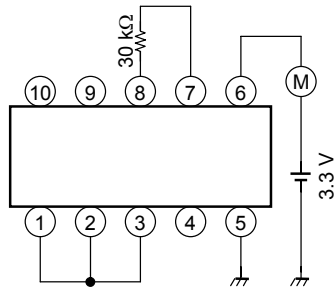


**Equivalent Circuit**

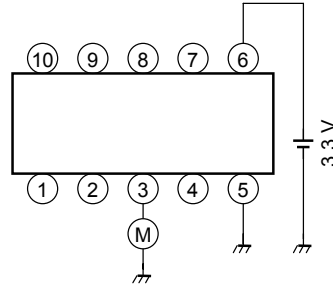


## Test Circuit

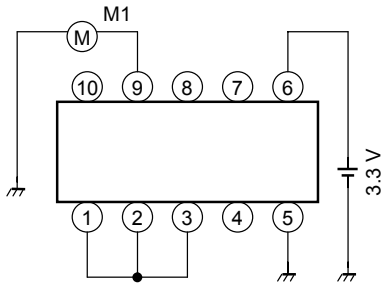
(1) Supply current **ICC**



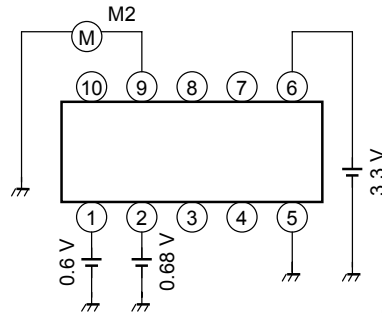
(2) GUARD  
Output voltage **VoGur**



(3) DIFF-AMP  
Gain **GvBuf**  
Step 1

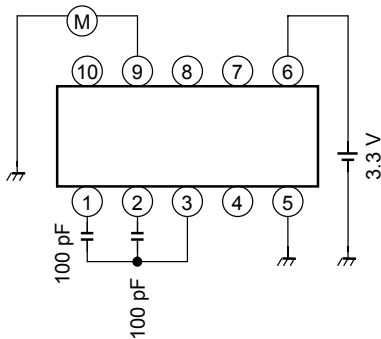


Step 2

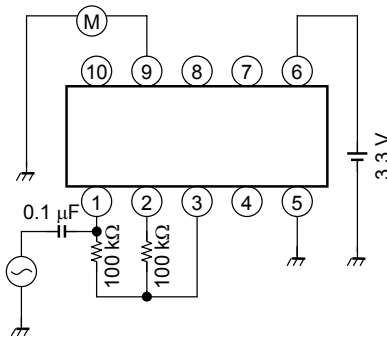


$$\text{Gain} = \frac{M2 - M1}{0.68 - 0.60}$$

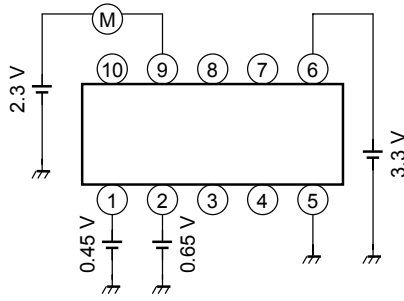
(4) DIFF-AMP  
Output DC voltage **VoBuf**



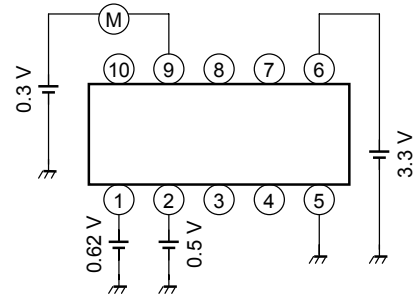
(5) DIFF-AMP  
Low pass filter cut-off freq. **fc**



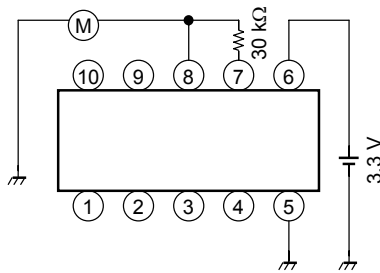
(6) DIFF-AMP  
Output source current **IBso**



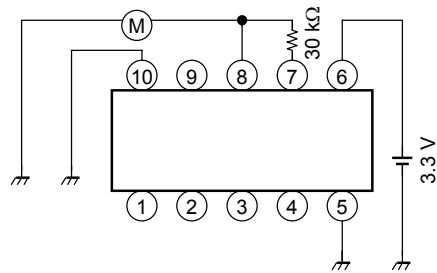
(7) DIFF-AMP  
Output sink current **IBsi**



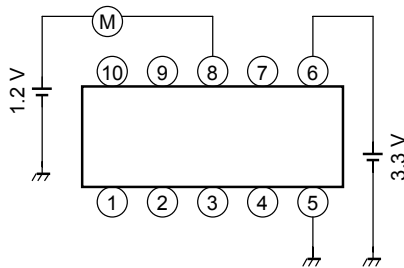
(8) OP-AMP  
Input voltage 1 **Vin1**



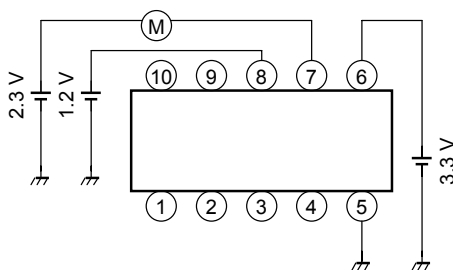
(9) OP-AMP  
Input voltage 2 **Vin2**



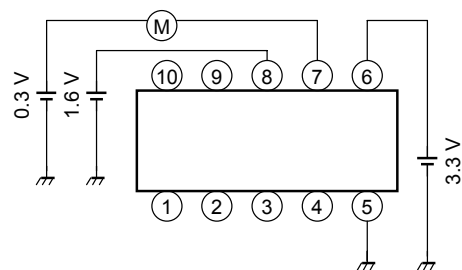
(10) OP-AMP  
Input current **Iin**



(11) OP-AMP  
Output source current **IAso**

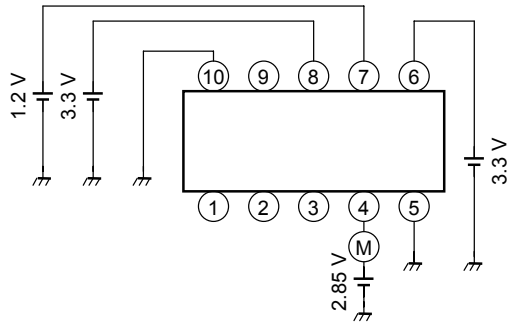


(12) OP-AMP  
Output sink current **IAsi**

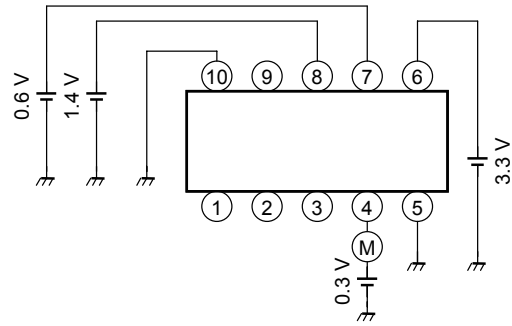




(13) Window comparator  
Output source current  $I_{Wso}$

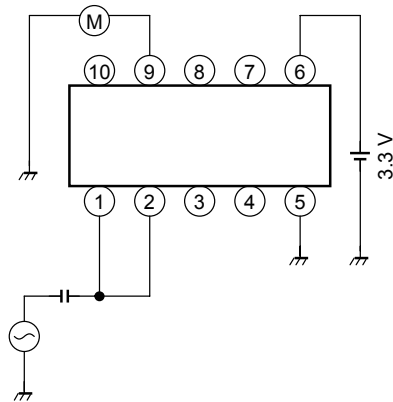


(14) Window comparator  
Output sink current  $I_{Wsi}$

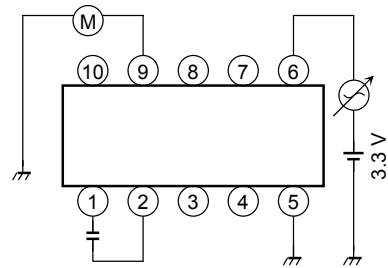


**Test Circuit (for reference)**

(a) DIFF-AMP  
CMRR



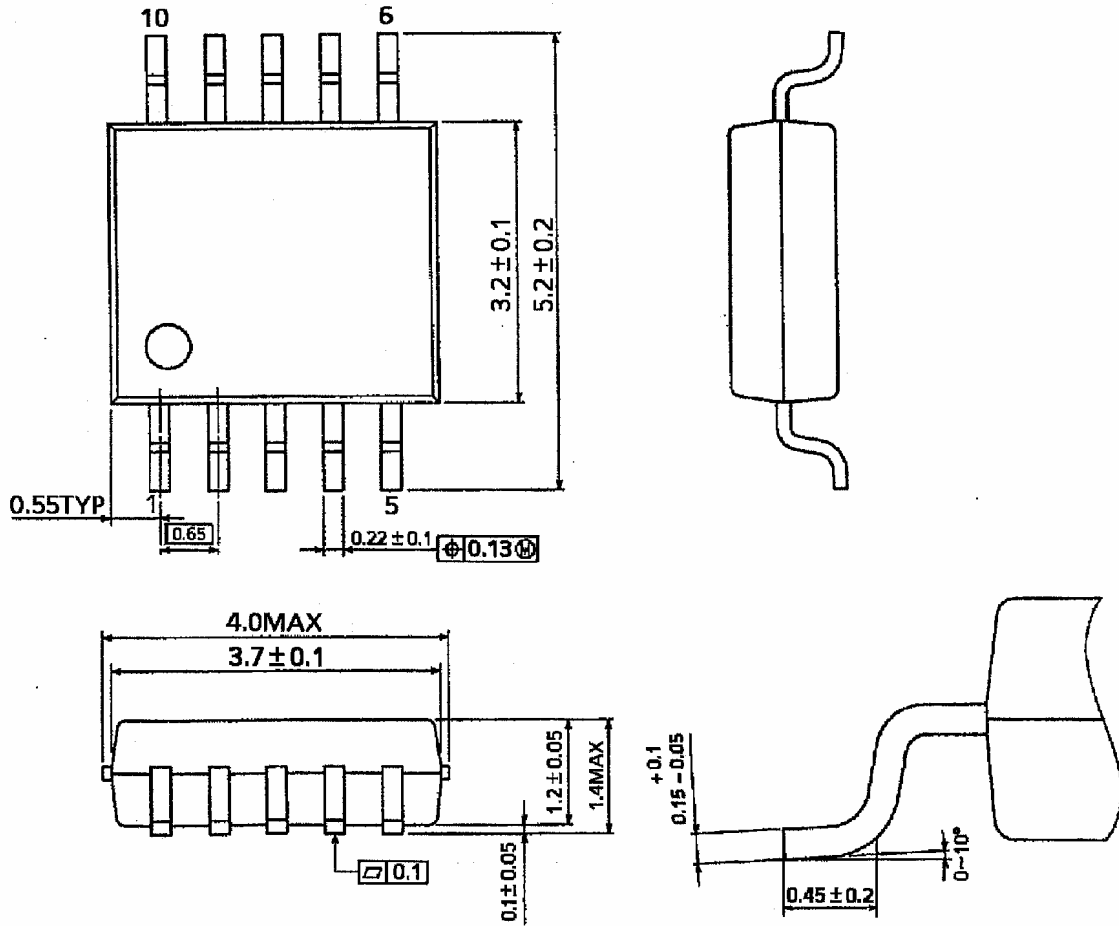
(b) DIFF-AMP  
PSRR



## Package Dimensions

SSOP10-P-0.65A

Unit : mm



Weight: 0.04 g (typ.)

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