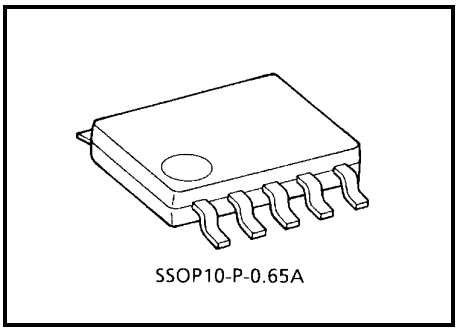
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA6009FN,TA6009FNG

Shock Sensor IC (1 ch version)

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

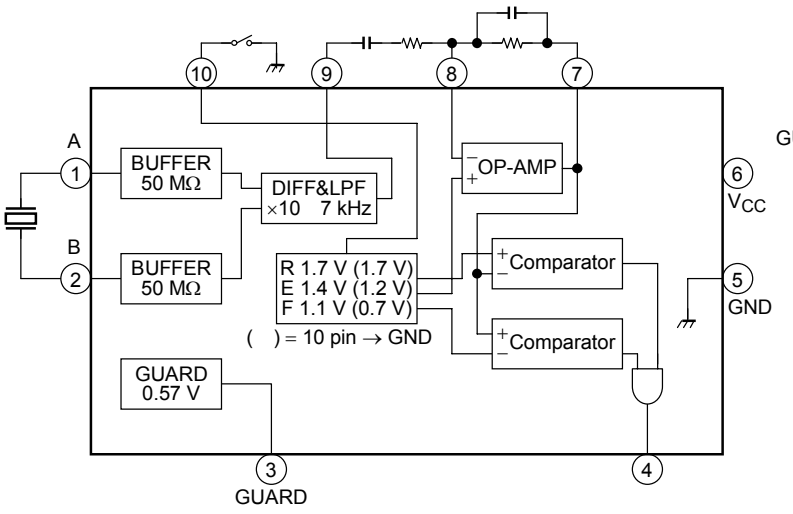


Weight: 0.04 g (typ.)

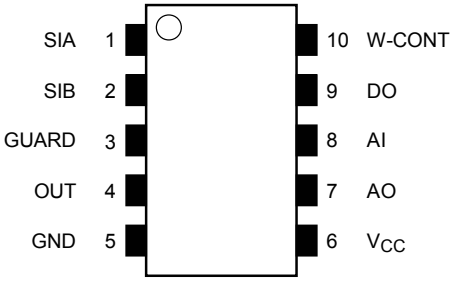
Features

- 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)

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_{CC}	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_{CC}	7	V
Power dissipation	P_D	300	mW
Storage temperature	T_{stg}	−55 to 150	°C

Recommend Operating Condition

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2.7 to 5.5	V
Operating temperature	T_{opr}	−25 to 85	°C

Electrical Characteristics (unless otherwise specified, V_{CC} = 3.3 V, Ta = 25°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 V		1.8	2.4	mA
			V_{CC} = 5.0 V		1.8	2.4	

(GUARD)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Output voltage	VoGur	(2)	—	0.52	0.57	0.62	V

(DIFF-AMP)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input impedance (Note 1)	Zin	—	—	50	100		MΩ
Gain	GvBuf	(3)	—	19.6	20	20.4	dB
Output DC voltage	VoBuf	(4)	Connect C = 100 pF between 1 pin and 2 pin	0.7	1	1.3	V
Low pass filter cut-off freq.	fc	(5)	Frequency at −3dB point	5	7	10	kHz
Output source current	IBso	(6)	Voh = V_{CC} − 1 V	400	800		μA
Output sink current	IBsi	(7)	Vol = 0.3 V	75	130		μA

Note 1: Marked parameters are reference data.

(OP-AMP)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Cut-off frequency (Note 1)	fT	—	—	1.5	2		MHz
Openloop gain (Note 1)	Gvo	—	—	80	90		dB
Input voltage 1	Vin1	(8)	10 pin → OPEN (Note 2)	1.33	1.4	1.47	V
Input voltage 2	Vin2	(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)	Voff	—	—	−5	0	5	mV
Output source current	IAso	(11)	Voh = V_{CC} − 1 V	300	800		μA
Output sink current	IAsi	(12)	Vol = 0.3 V	130	200		μA

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)	Vtrp1	—	10 pin → OPEN (Note 2)	Vin1 ±0.285	Vin1 ±0.3	Vin1 ±0.315	V
Trip voltage 2 (Note 1)	Vtrp2	—	10 pin → GND (Note 2)	Vin2 ±0.475	Vin2 ±0.5	Vin2 ±0.525	V
Output source current	IWso	(13)	Voh = V_{CC} − 0.5 V	30	50		μA
Output sink current	IWsi	(14)	Vol = 0.3 V	300	800		μA

Note 1: Marked parameters are reference data.

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

Application Note

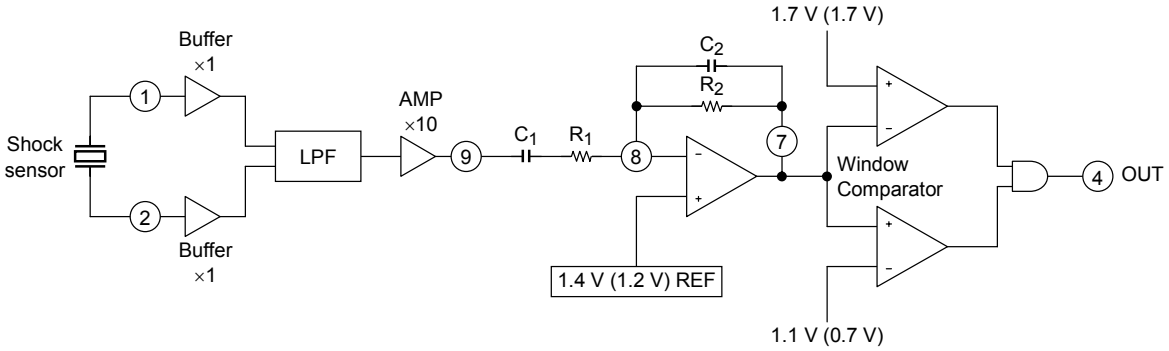


Figure 1 The Composition of G-Force Sense Amplifier

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

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

$G1/10 = G$ (OP-AMP)

(HPF setting)

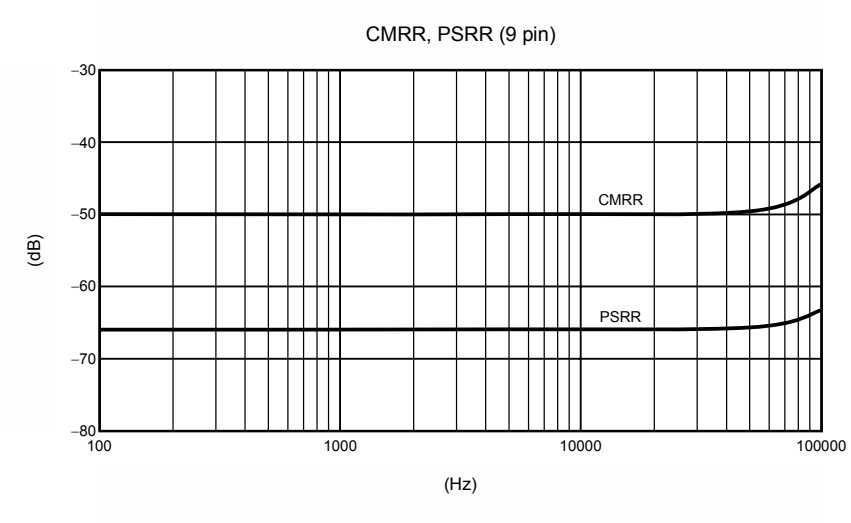
$fc = 1/(2 \pi \times R_1 \times C_1)$

(LPF setting)

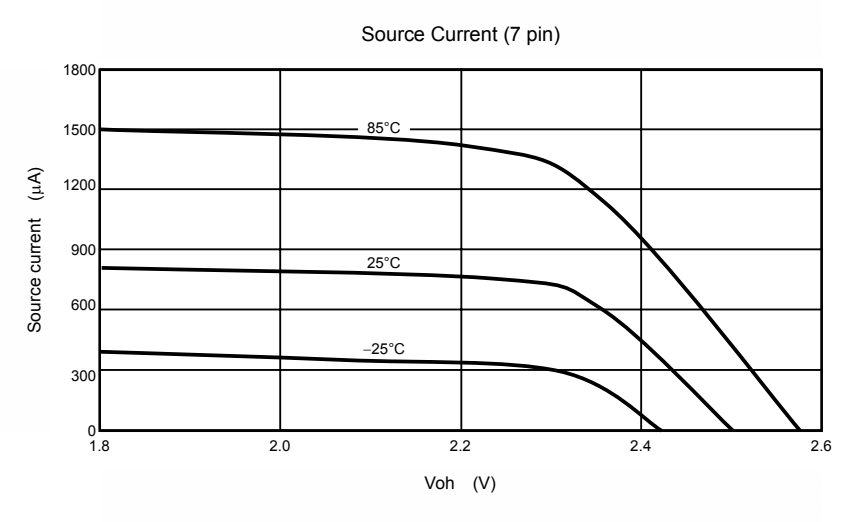
$fc = 1/(2 \pi \times R_2 \times C_2)$

Reference Data

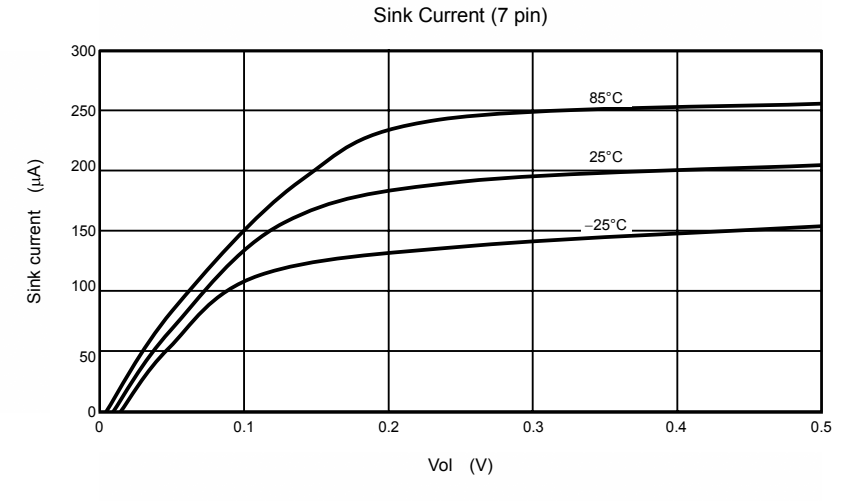
(1) 9 pin (DIFF-AMP output) CMRR, PSRR



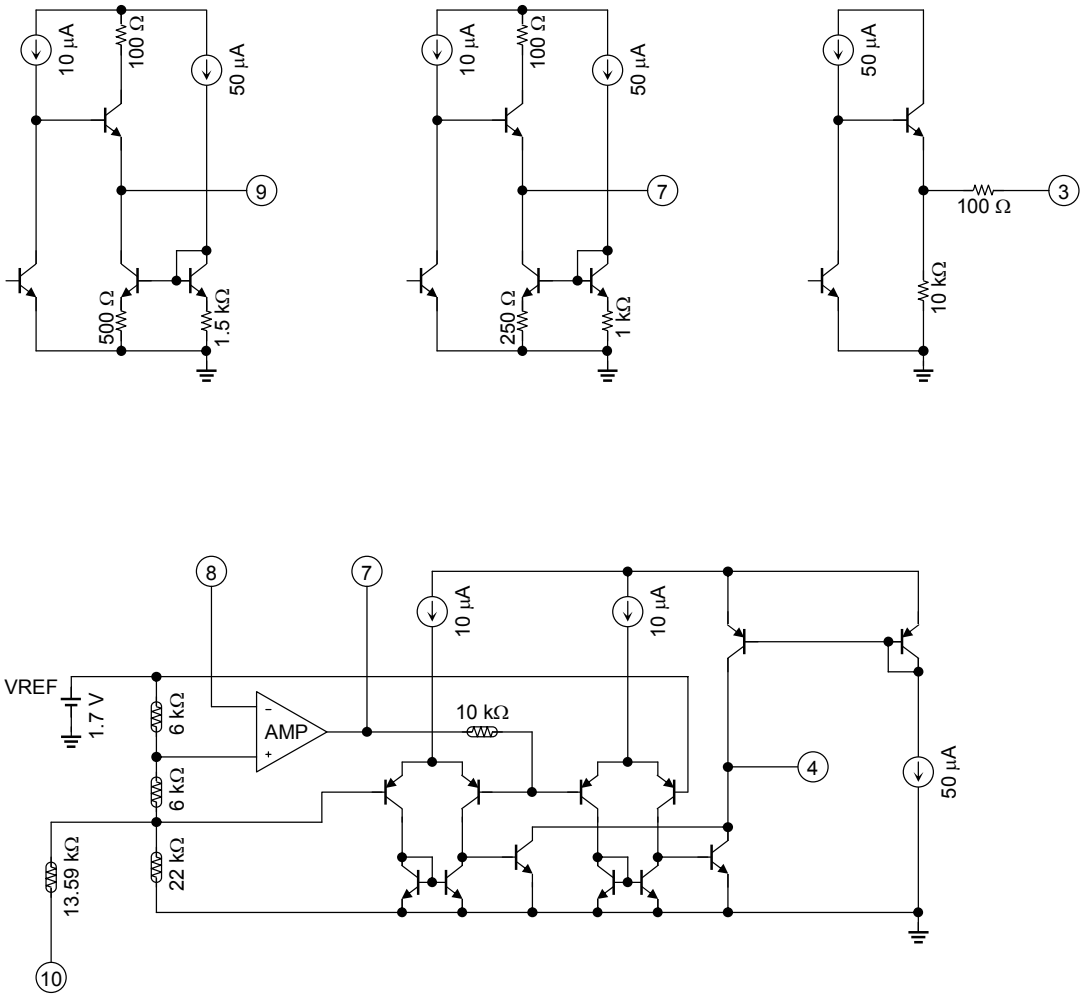
(2) 7 pin (OP-AMP output) source current



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

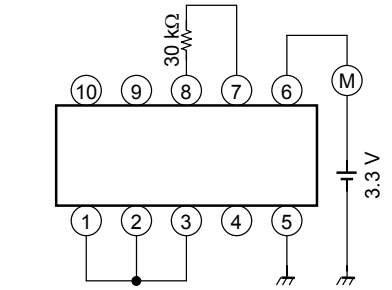


Equivalent Circuit

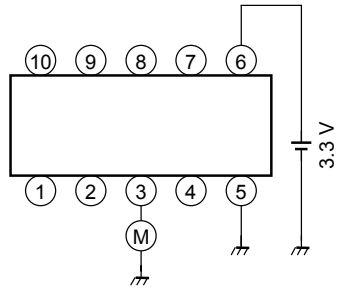


Test Circuit

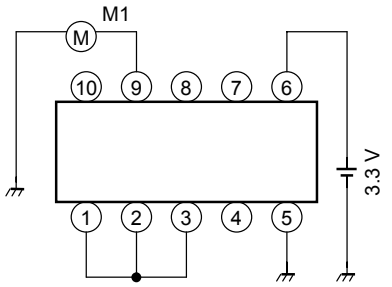
(1) Supply current **ICC**



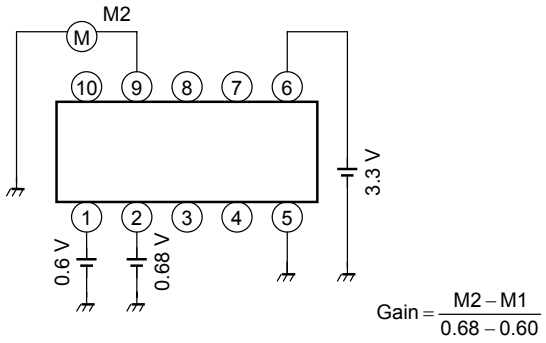
(2) GUARD
Output voltage **VoGur**



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

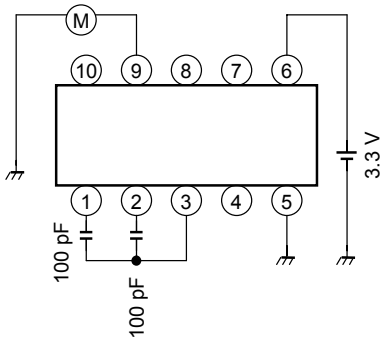


Step 2

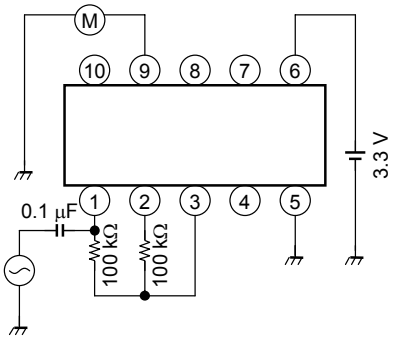


$$\text{Gain} = \frac{M2 - M1}{0.68 - 0.60}$$

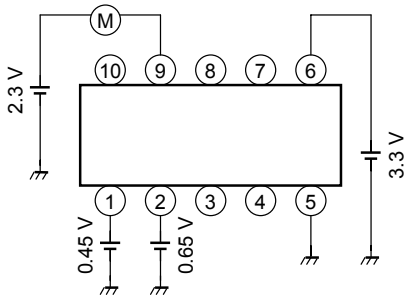
(4) DIFF-AMP
Output DC voltage **VoBuf**



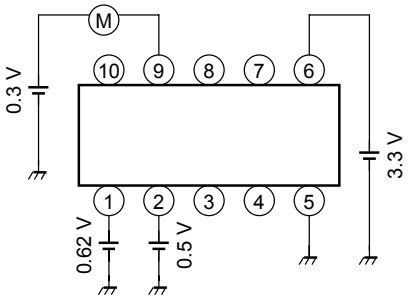
(5) DIFF-AMP
Low pass filter cut-off freq. **fc**



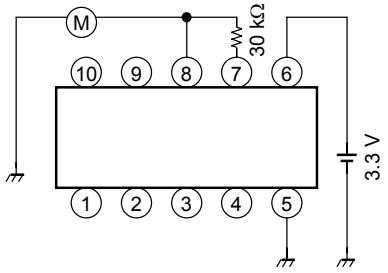
(6) DIFF-AMP
Output source current **IBso**



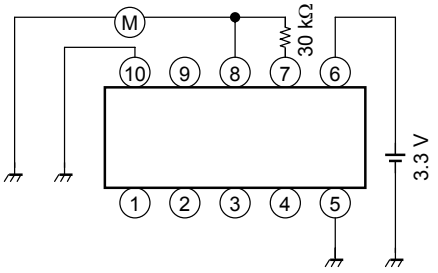
(7) DIFF-AMP
Output sink current **IBsi**



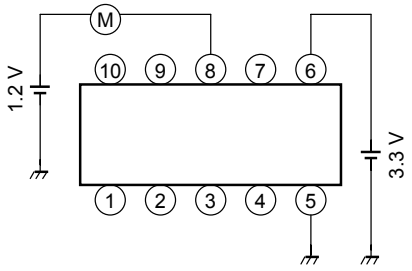
(8) OP-AMP
Input voltage 1 **Vin1**



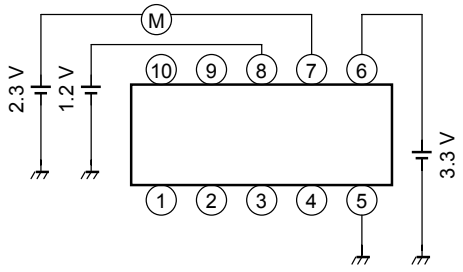
(9) OP-AMP
Input voltage 2 **Vin2**



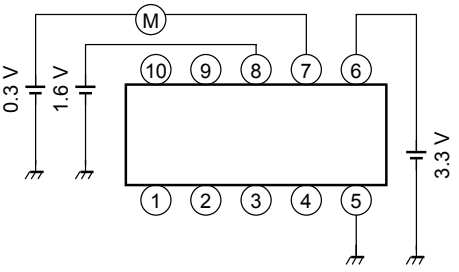
(10) OP-AMP
Input current $\mathbf{I_{in}}$



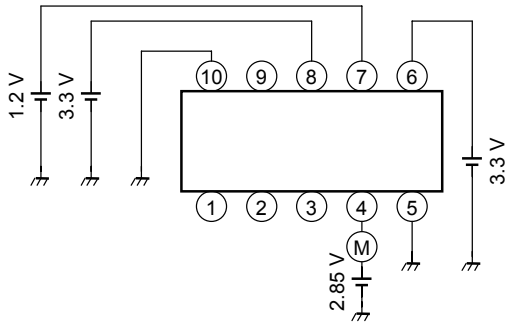
(11) OP-AMP
Output source current **IAso**



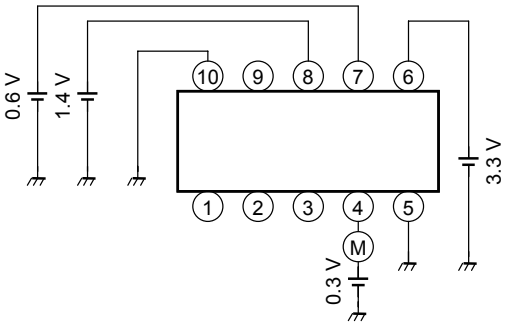
(12) OP-AMP
Output sink current **IAsi**



(13) Window comparator
Output source current **IWso**

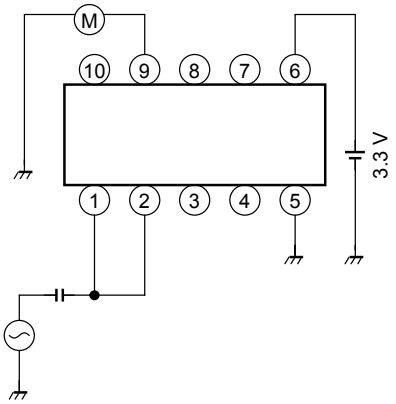


(14) Window comparator
Output sink current **IWsi**

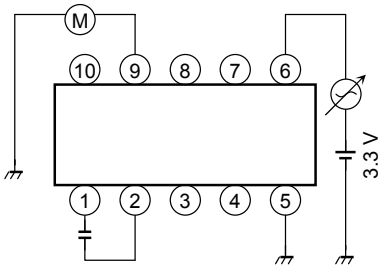


Test Circuit (for reference)

(a) DIFF-AMP
CMRR

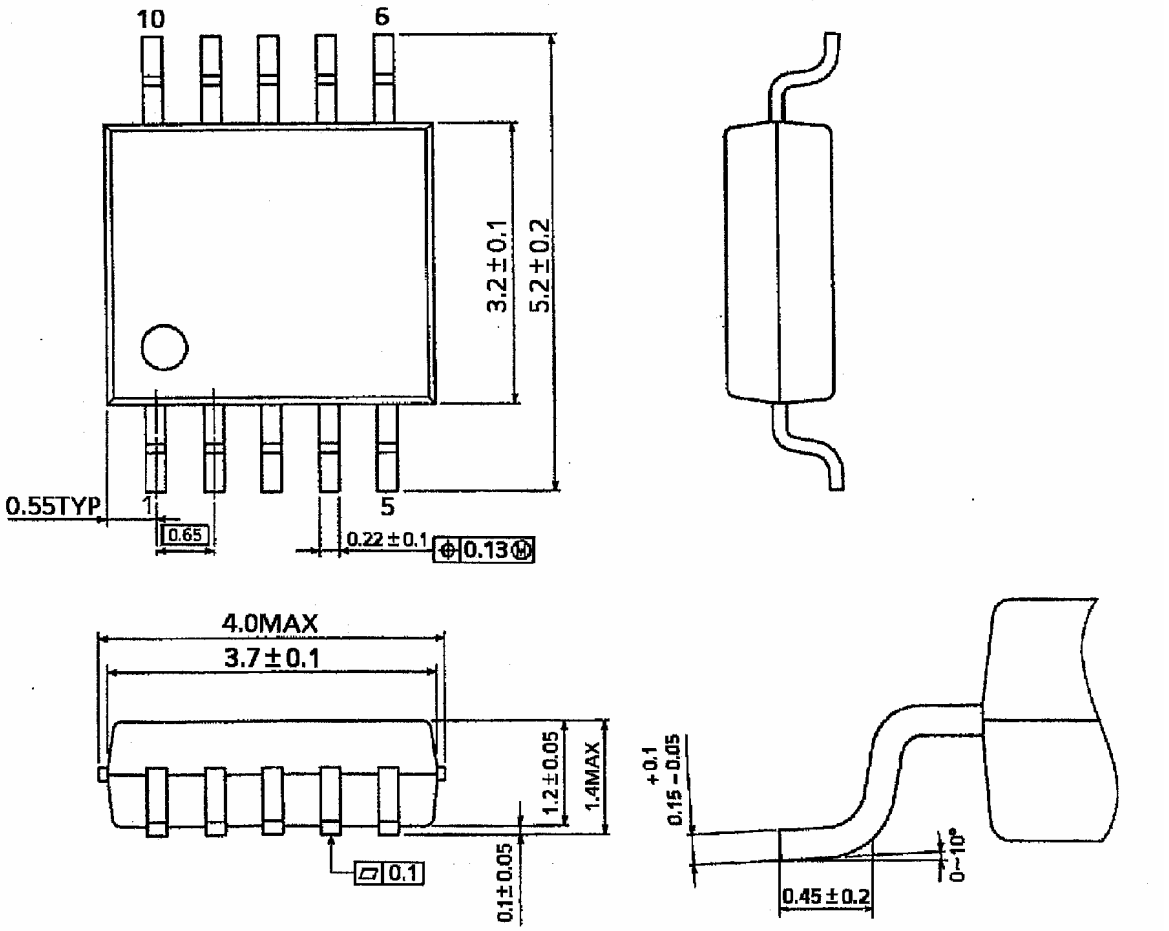


(b) DIFF-AMP
PSRR



Package Dimensions

SSOP10-P-0.65A Unit : mm



Weight: 0.04 g (typ.)

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