

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA6039FN

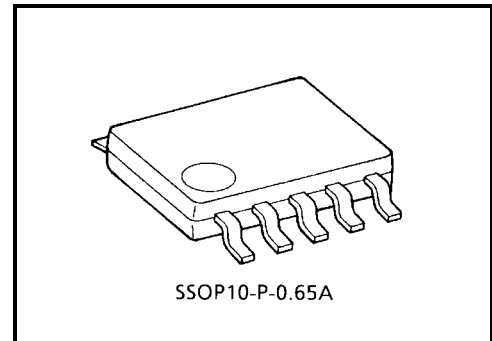
Shock Sensor IC

TA6039FN detects an existence of external shock through the shock sensor and output.

Compared with TA6009FN, S/N ratio is improved by 8dB. It is suitable for applications which require low-noise operation.

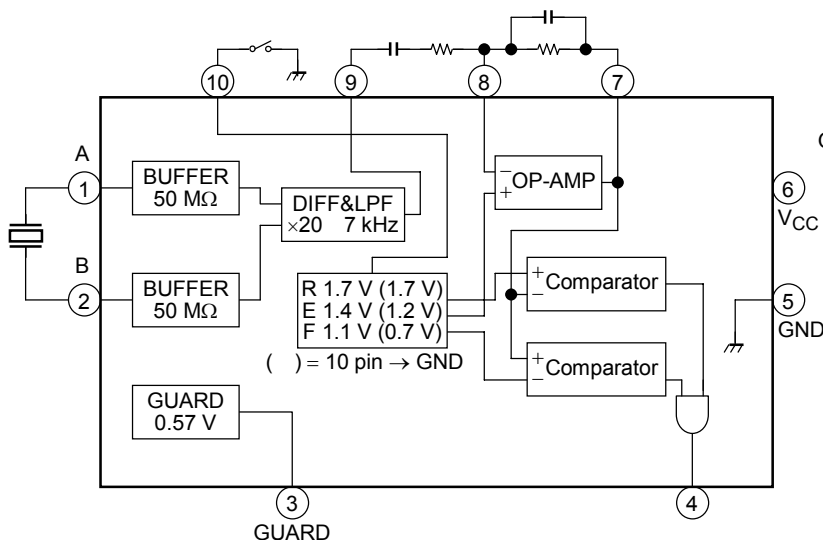
Features

- TA6039FN 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.
- TA6039FN incorporates 1-ch shock detecting circuitry.
- Input terminal of sensor signal is designed high impedance.
 - Differential input impedance = 100 M Ω (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)

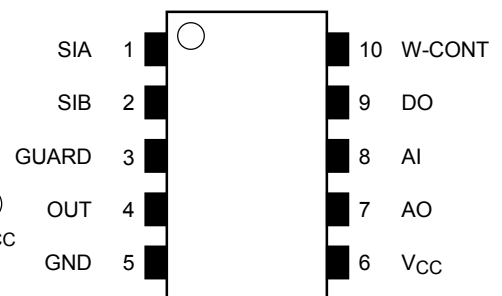


Weight: 0.04 g (typ.)

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 _{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	Window-comparator 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

Note: The IC may be destroyed due to short circuit between adjacent pins, incorrect orientation of device's mounting, connecting positive and negative power supply pins wrong way round, air contamination fault, or fault by improper grounding.

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	2.6	mA
			$V_{CC} = 5.0\text{ V}$		1.8	2.7	

(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}	—		30	100		$M\Omega$
Gain	G_{vBuf}	(3)		25.6	26.0	26.4	dB
Output DC voltage	V_{oBuf}	(4)	Connect C = 100 pF between 1 pin, 2 pin and 3 pin	0.7	1	1.3	V
Low pass filter cut-off frequency	f_c	(5)	Frequency at -3dB point	5	7	10	kHz
Output source current	$I_{B_{SO}}$	(6)	$V_{oh} = V_{CC} - 1\text{ V}$	350	800		μA
Output sink current	$I_{B_{Si}}$	(7)	$V_{ol} = 0.3\text{ V}$	75	130		μA

(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	$I_{A_{SO}}$	(11)	$V_{oh} = V_{CC} - 1\text{ V}$	300	800		μA
Output sink current	$I_{A_{Si}}$	(12)	$V_{ol} = 0.3\text{ V}$	130	200		μA

(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 2)	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	$I_{W_{SO}}$	(13)	$V_{oh} = V_{CC} - 0.5\text{ V}$	30	50		μA
Output sink current	$I_{W_{Si}}$	(14)	$V_{ol} = 0.3\text{ V}$	300	800		μA

Note 1: Marked parameters are reference data.

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

Application Note

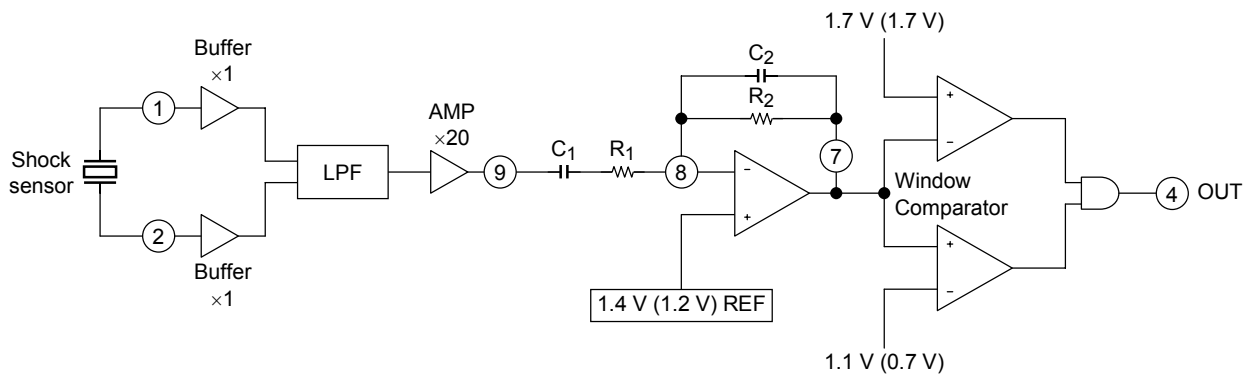


Figure 1 The Composition of G-Force Sense Amplifier

Figure 1 shows the configuration of G-Force sensor amplifier. The shock sensor is connected between the pins 1 and 2. External resistor R₁ and R₂ are used to adjust the sensitivity.

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.

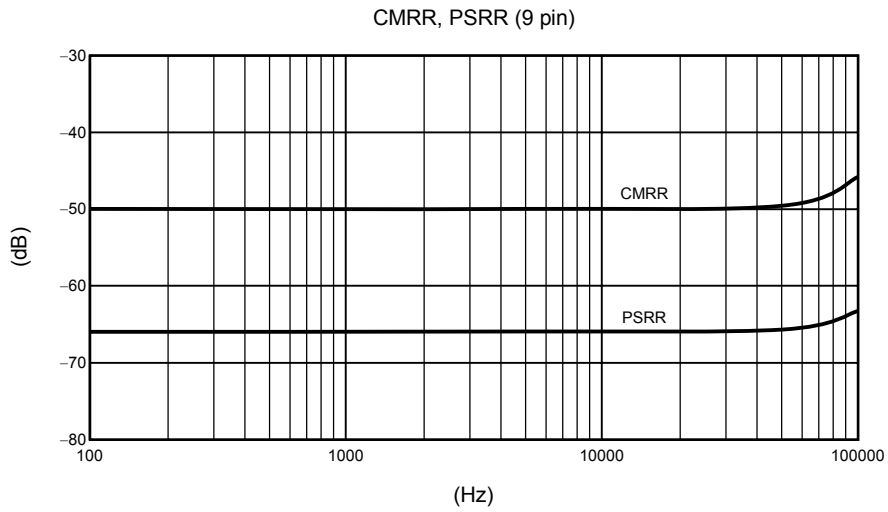
(gain setting) * 10 PIN → GND
 $500/(s \times g) = G1$
 $G1/20 = G \text{ (OP-AMP)}$

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

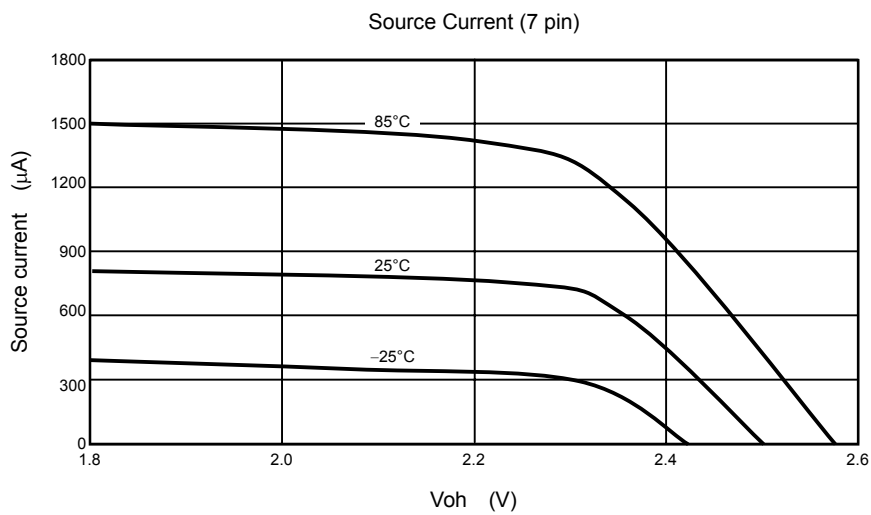
(LPF setting)
 $f_c = 1/(2 \pi \times R_2 \times C_2)$

Reference Data

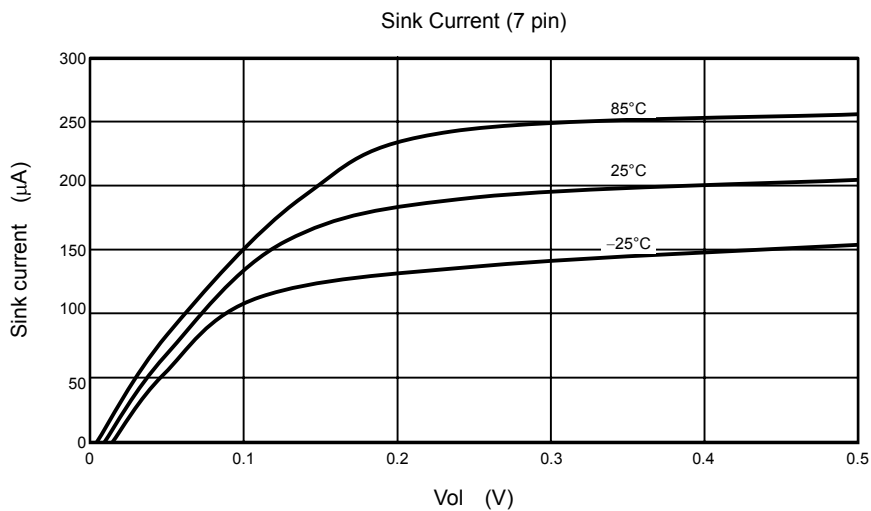
- (1) 9 pin (DIFF-AMP output) CMRR, PSRR



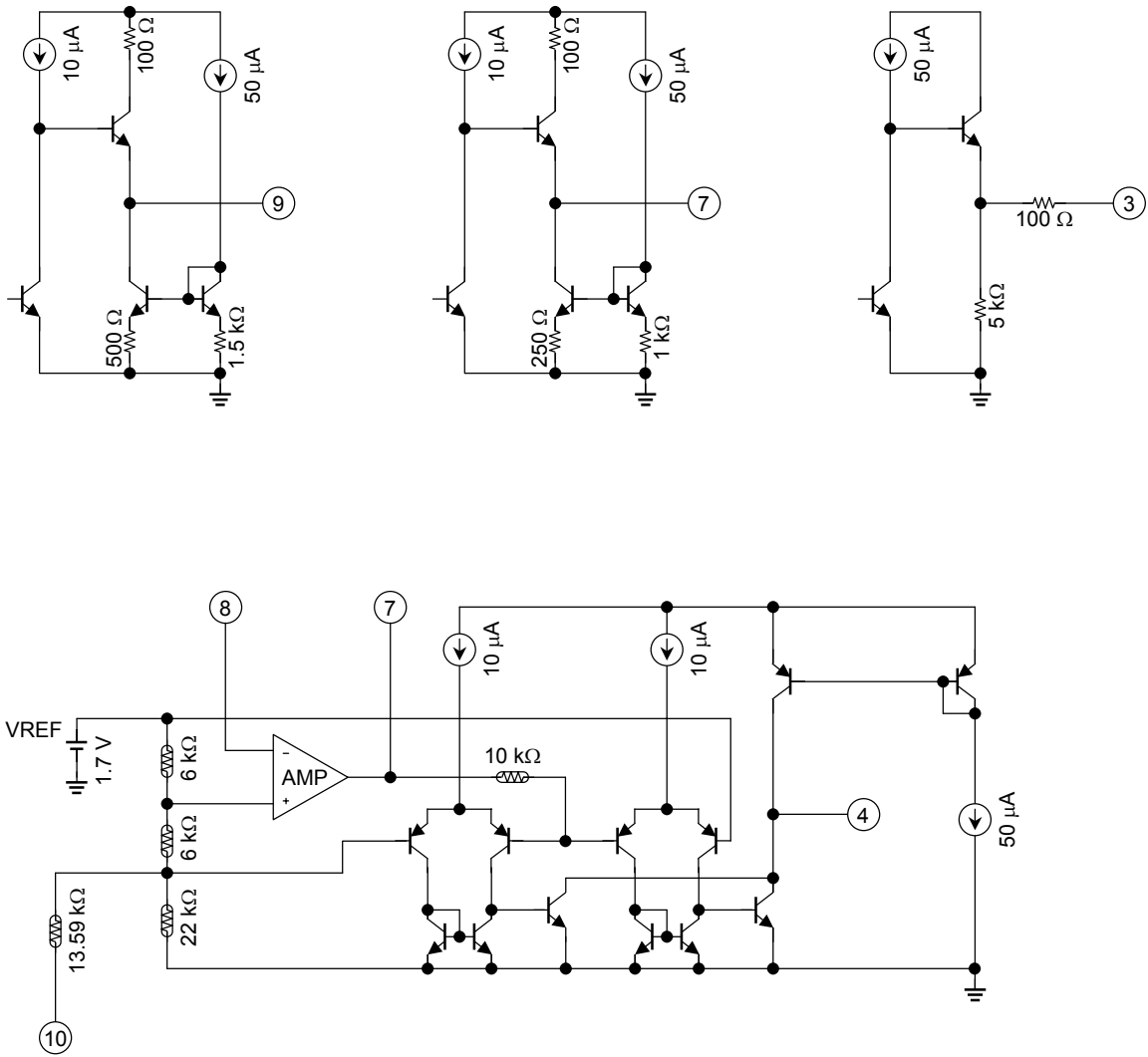
- (2) 7 pin (OP-AMP output) source current



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

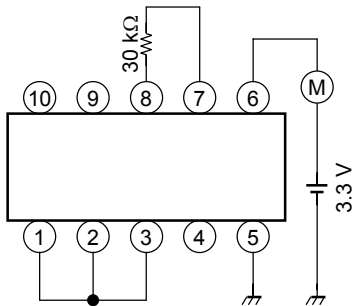


Equivalent Circuit

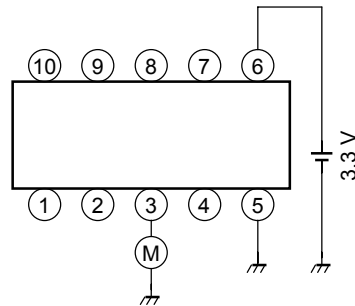


Test Circuit

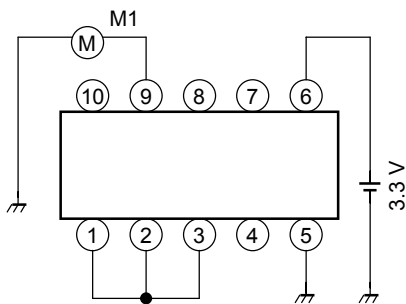
(1) Supply current **ICC**



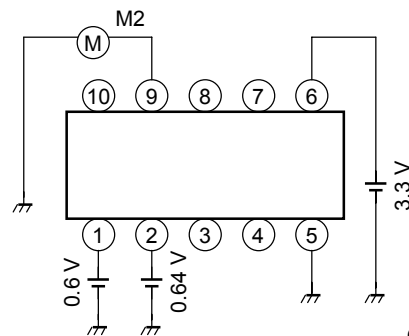
(2) GUARD Pin
Output voltage **VoGur**



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

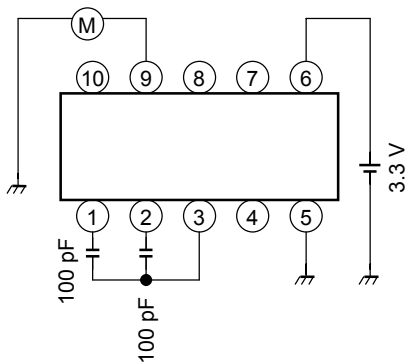


Step 2

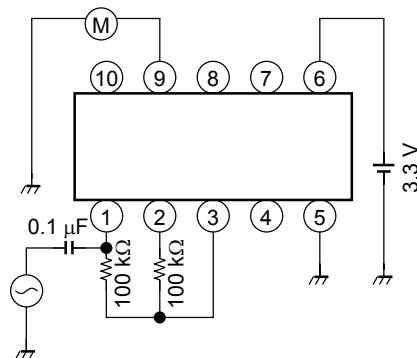


$$\text{Gain} = \frac{M2 - M1}{0.64 - 0.60}$$

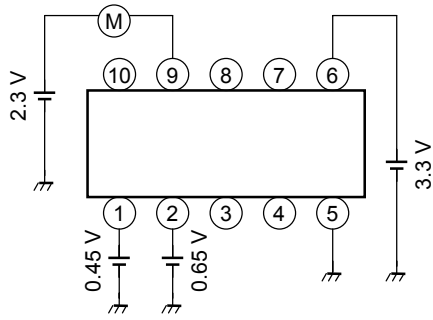
(4) DIFF-AMP
Output DC voltage **VoBuf**



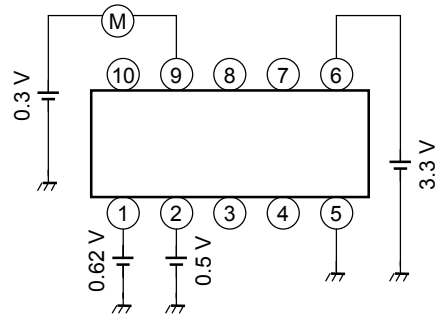
(5) DIFF-AMP
Low cut-off frequency **fc**



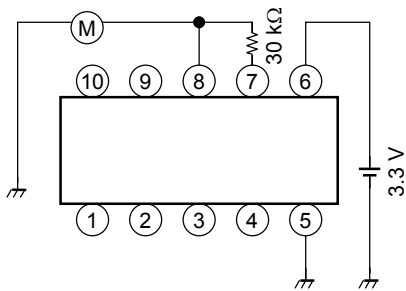
(6) DIFF-AMP
Output source current I_{Bso}



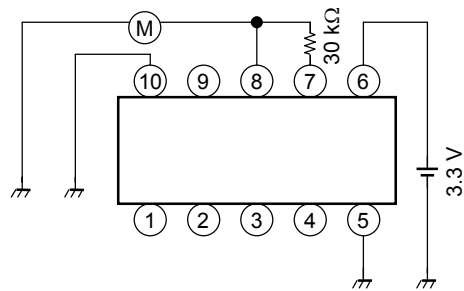
(7) DIFF-AMP
Output sink current I_{Bsi}



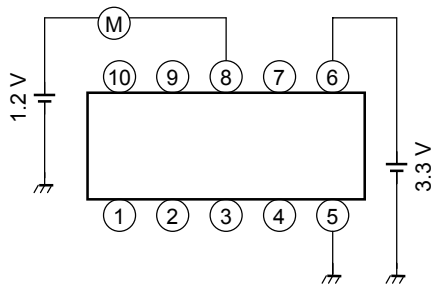
(8) OP-AMP
Input voltage 1 V_{in1}



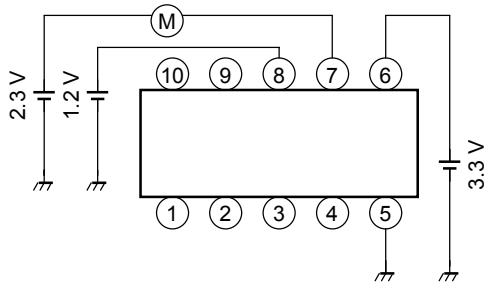
(9) OP-AMP
Input voltage 2 V_{in2}



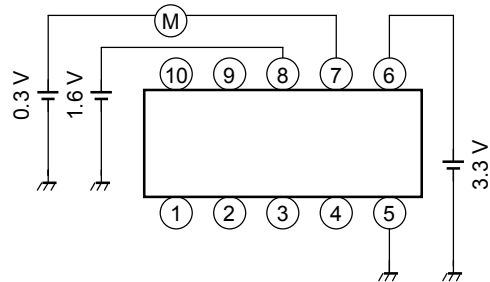
(10) OP-AMP
Input current I_{in}



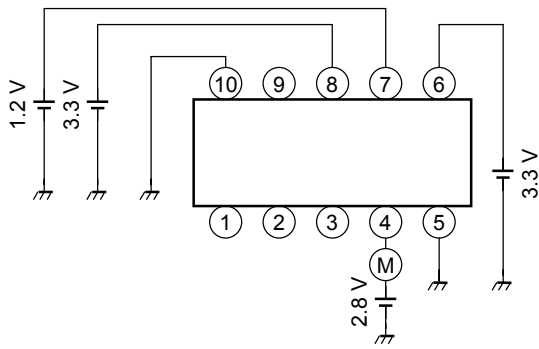
(11) OP-AMP
Output source current I_{Aso}



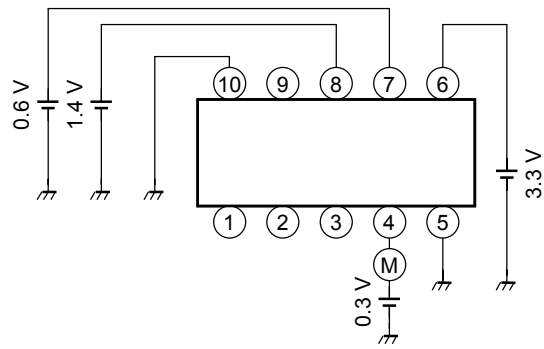
(12) OP-AMP
Output sink current I_{Asi}



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

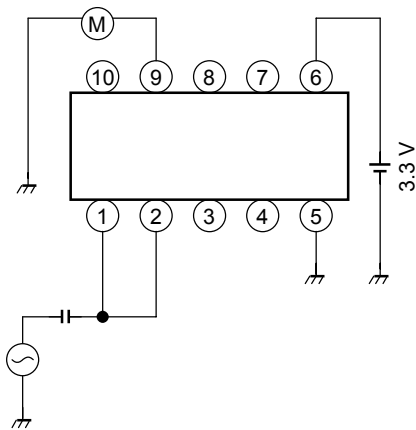


(14) Window comparator
Output sink current I_{Wsi}

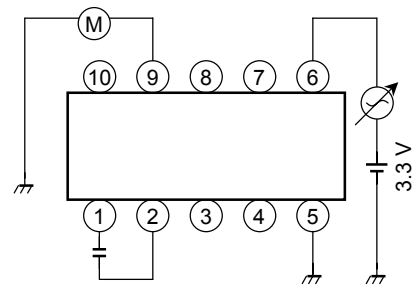


Test Circuit (for reference)

(a) DIFF-AMP
CMRR



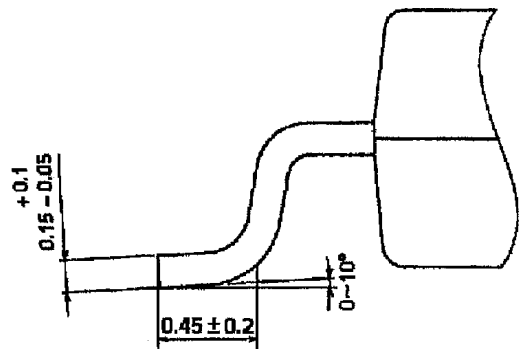
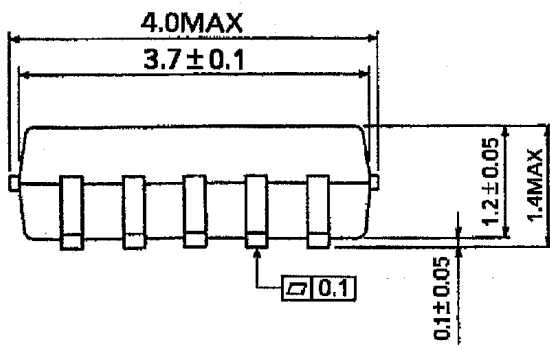
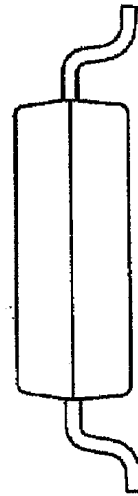
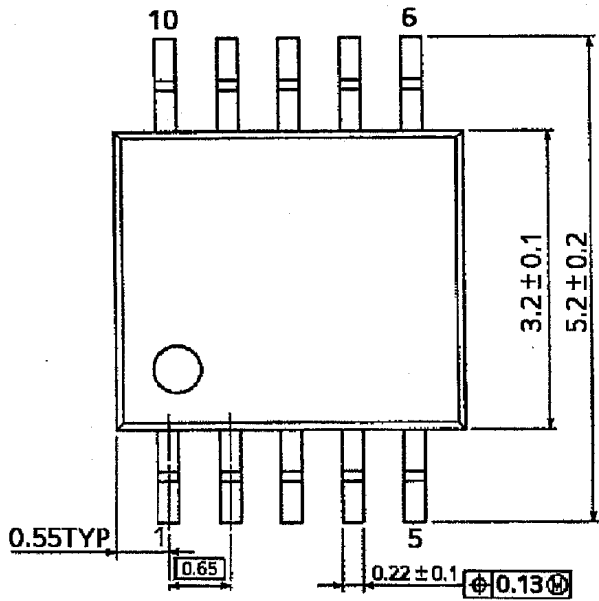
(b) DIFF-AMP
PSRR



Package Dimensions

SSOP10-P-0.65A

Unit : mm



Weight: 0.04 g (typ.)

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