

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

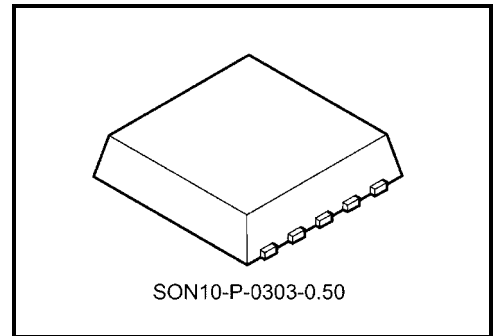
TA6009FM

Shock Sensor IC (1 ch version)

TA6009FM detects an existence of external shock through the shock sensor and output.

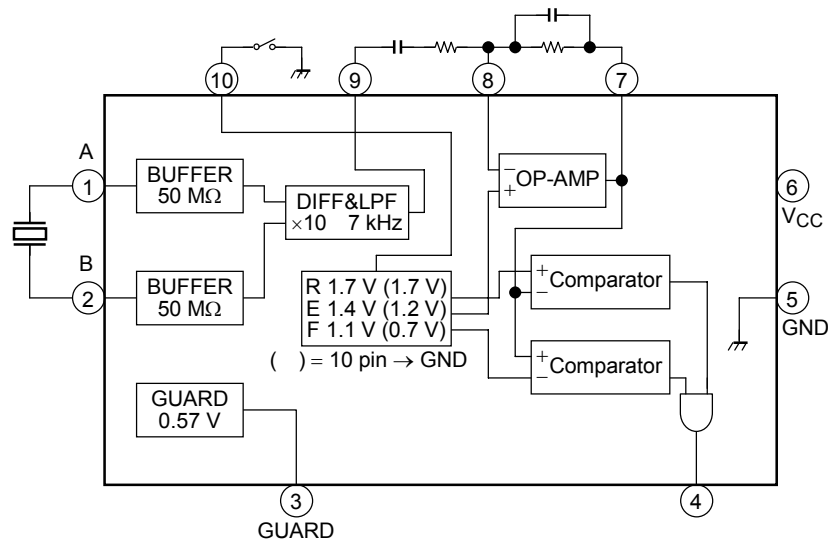
Features

- TA6009FM 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.
- TA6009FM 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
SON10-P-0303-0.50 (0.5 mm pitch)

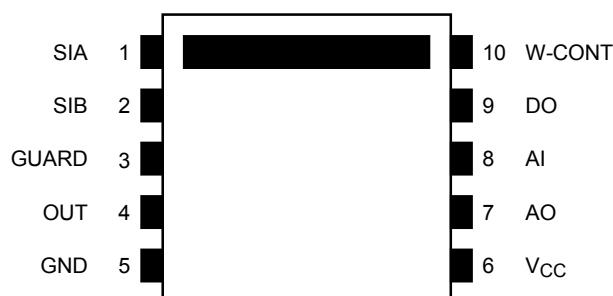


Weight: 0.016 g (typ.)

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	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	150	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	2.4	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		μA
Output sink current	I_{Bsi}	(7)	$V_{ol} = 0.3\text{ V}$	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)	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		μA
Output sink current	I_{Asi}	(12)	$V_{ol} = 0.3\text{ V}$	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)	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		μA
Output sink current	I_{Wsi}	(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

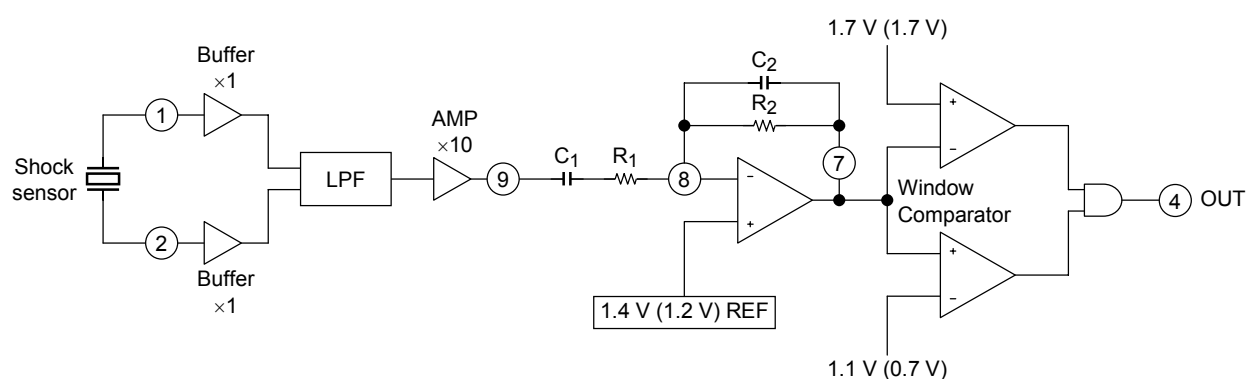


Figure 1 The configuration of G-force sensor amplifier

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)

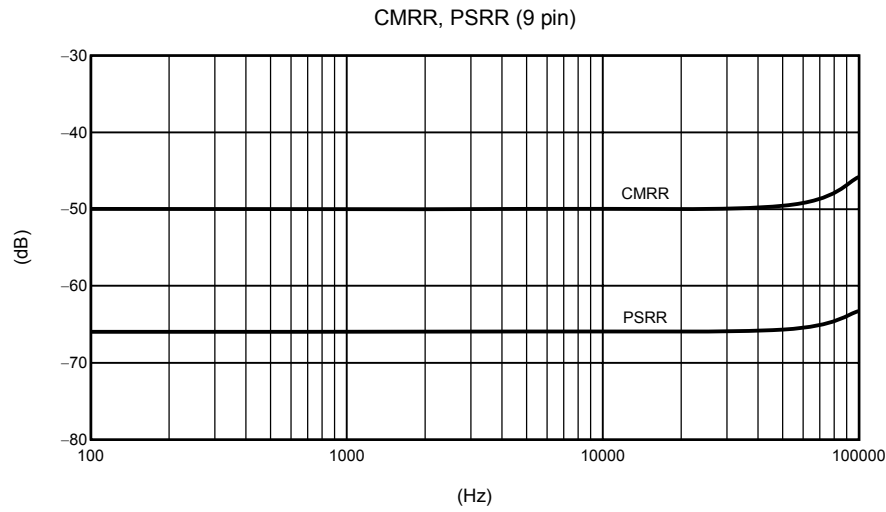
$$f_c = 1/(2 \pi \times R_1 \times C_1)$$

(LPF setting)

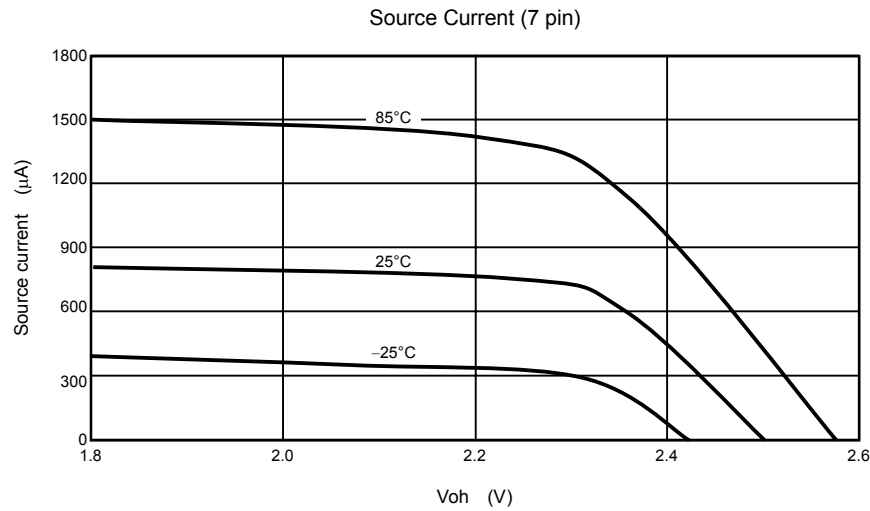
$$f_c = 1/(2 \pi \times R_2 \times C_2)$$

Reference Data

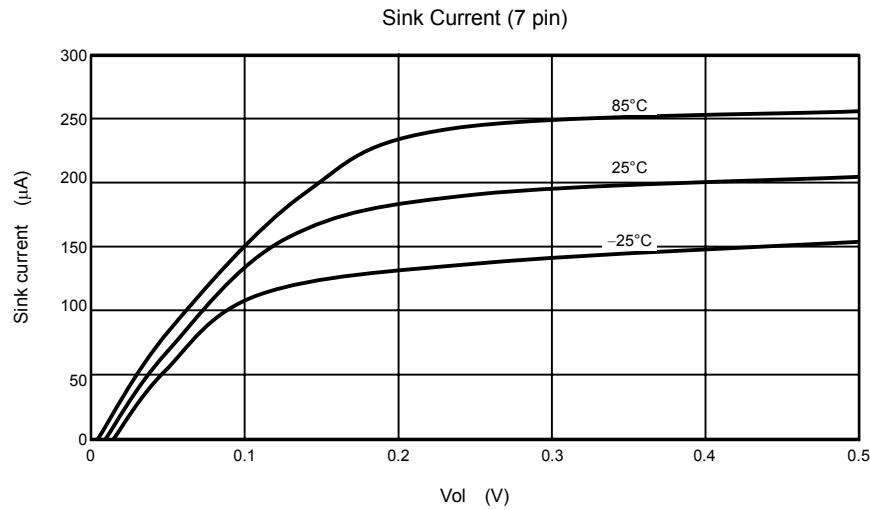
(1) 9 pin (DIFF-AMP output) CMRR, PSRR



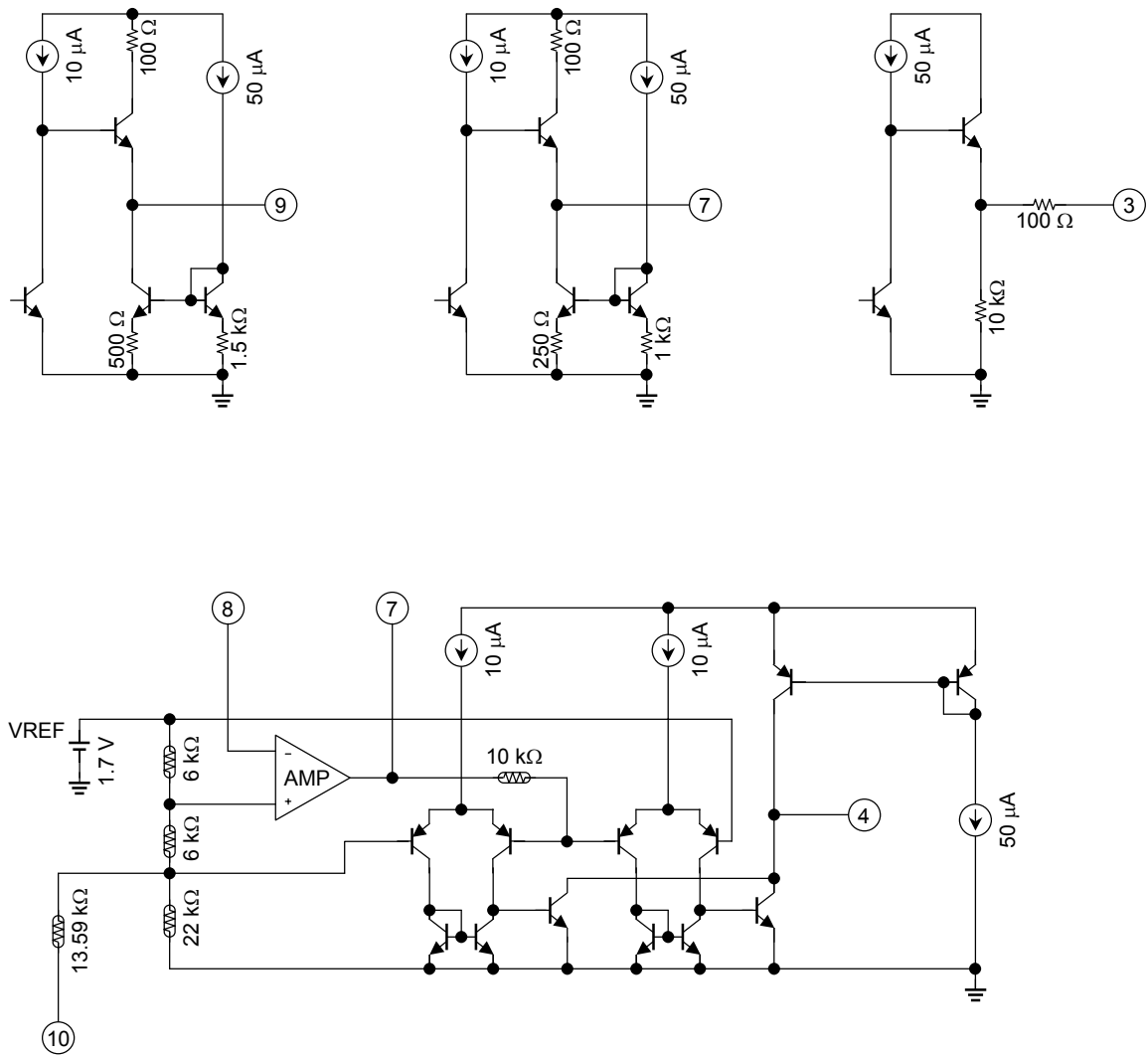
(2) 7 pin (OP-AMP output) source current



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

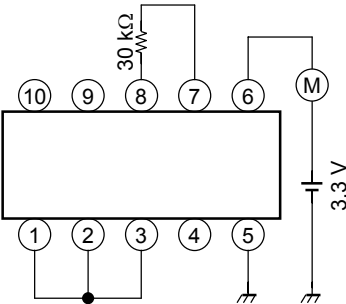


Equivalent Circuit

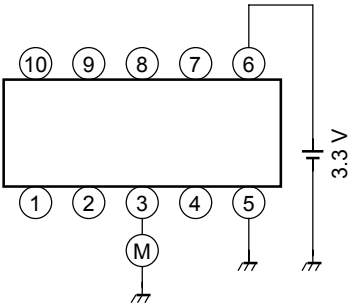


Test Circuit

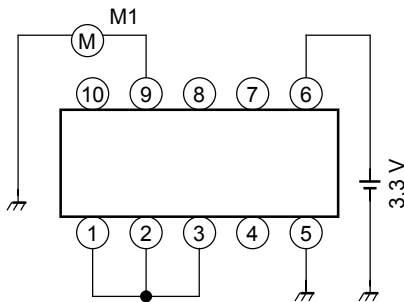
(1) Supply current **I_{CC}**



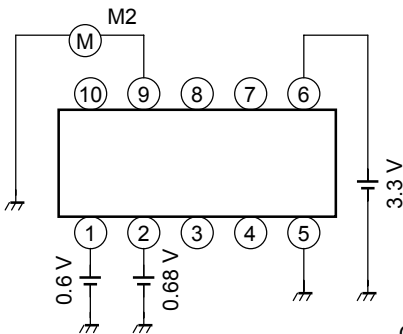
(2) **GUARD**
Output voltage **V_{oGu}**



(3) **DIFF-AMP**
Gain **G_{vBuf}**
Step 1

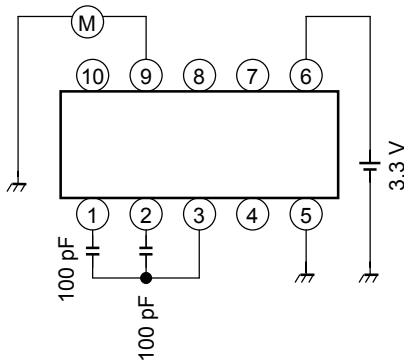


Step 2

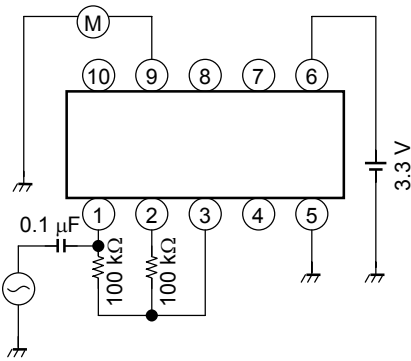


$$\text{Gain} = \frac{M2 - M1}{0.68 - 0.60}$$

(4) **DIFF-AMP**
Output DC voltage **V_{oBuf}**

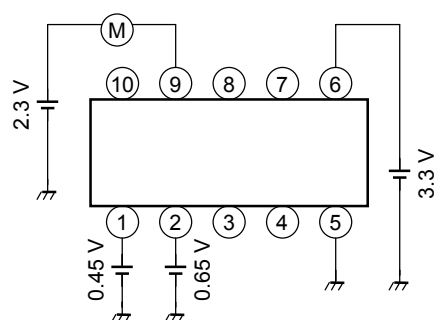


(5) **DIFF-AMP**
Low pass filter cut-off freq. **f_c**



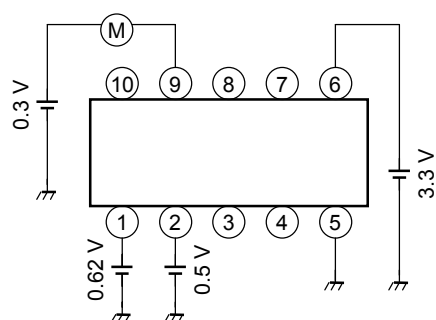
(6) DIFF-AMP

Output source current I_{Bso}



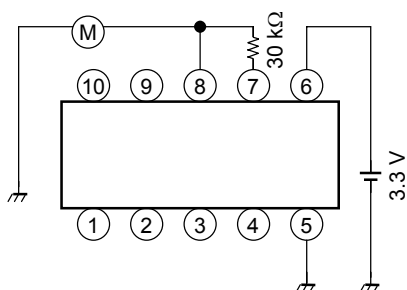
(7) DIFF-AMP

Output sink current I_{Bsi}



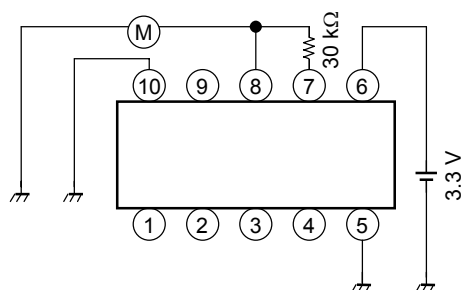
(8) OP-AMP

Input voltage 1 V_{in1}



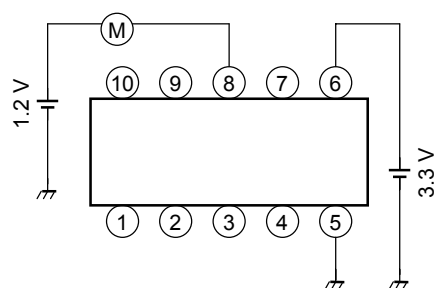
(9) OP-AMP

Input voltage 2 V_{in2}



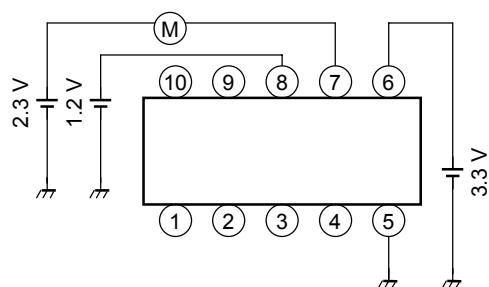
(10) OP-AMP

Input current I_{in}



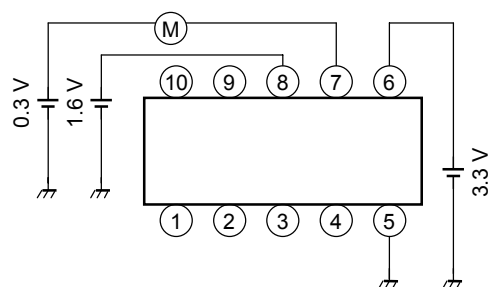
(11) OP-AMP

Output source current I_{Aso}

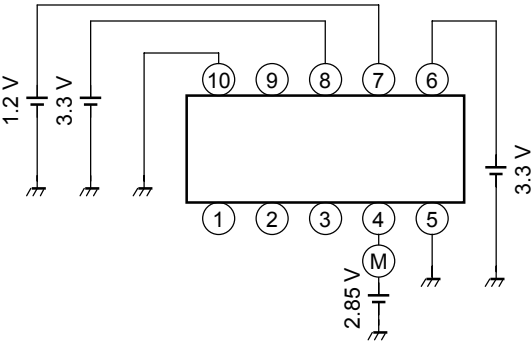


(12) OP-AMP

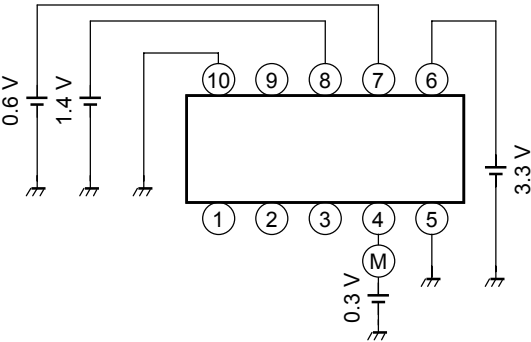
Output sink current I_{Asi}



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

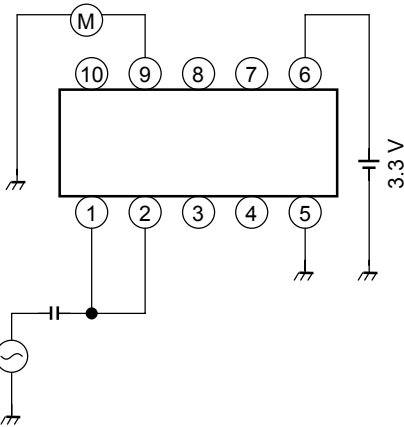


(14) Window comparator
Output sink current I_{Wsi}

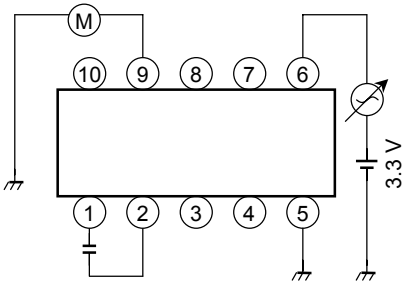


Test Circuit (for reference)

(a) DIFF-AMP
CMRR



(b) DIFF-AMP
PSRR



D 0 1
Q A 1

D 0 1
Q A 1

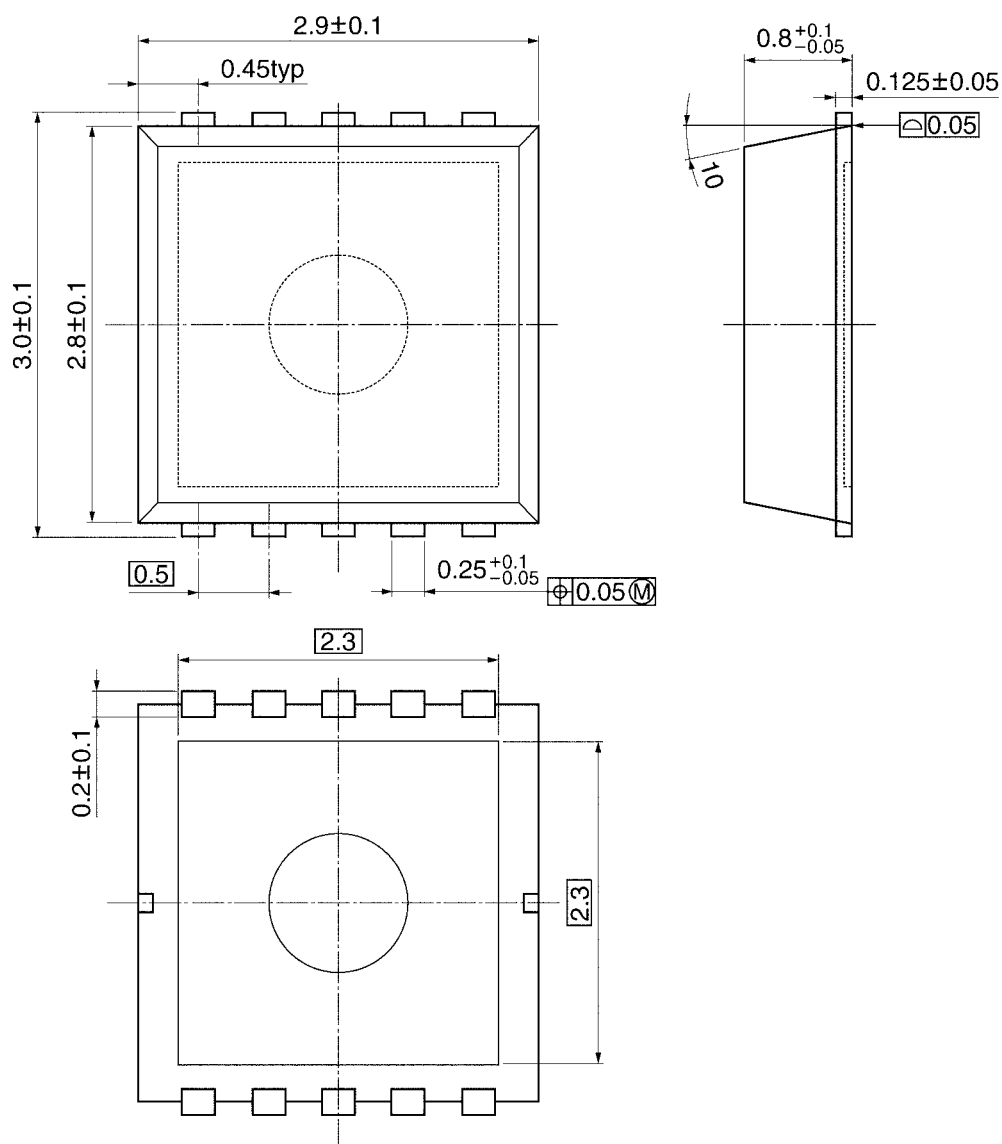
D 0 1
Q A 1

Back end process TOSHIBA Kitakyushu factory

Package Dimensions

SON10-P-0303-0.50

Unit: mm



Weight: 0.016 g (typ.)

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000707EBA

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