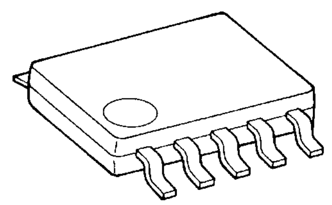
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

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.

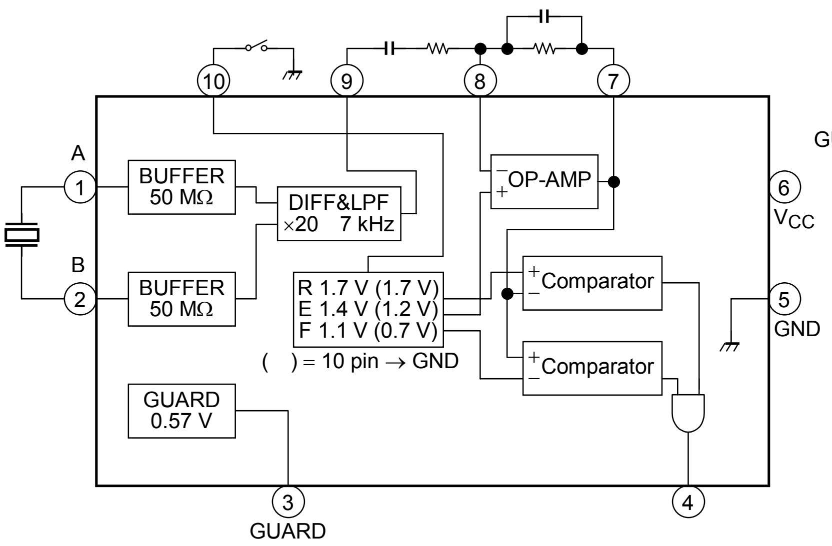


Weight: 0.04 g (typ.)

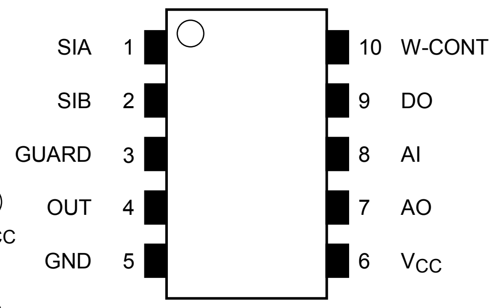
Features

- 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 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	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 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	2.6	mA
			V_{CC} = 5.0 V		1.8	2.7	

(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	—		30	100		MΩ
Gain	GvBuf	(3)		25.6	26.0	26.4	dB
Output DC voltage	VoBuf	(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	fc	(5)	Frequency at −3dB point	5	7	10	kHz
Output source current	IB_{so}	(6)	Voh = V_{CC} − 1 V	350	800		μA
Output sink current	IB_{si}	(7)	Vol = 0.3 V	75	130		μA

(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	Iin	(10)			25	50	nA
Offset voltage (Note 1)	Voff	—		−5	0	5	mV
Output source current	IA_{so}	(11)	Voh = V_{CC} − 1 V	300	800		μA
Output sink current	IA_{si}	(12)	Vol = 0.3 V	130	200		μA

(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 2)	Vtrp2	—	10 pin → GND (Note 2)	Vin2 ±0.475	Vin2 ±0.5	Vin2 ±0.525	V
Output source current	IW_{so}	(13)	Voh = V_{CC} − 0.5 V	30	50		μA
Output sink current	IW_{si}	(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

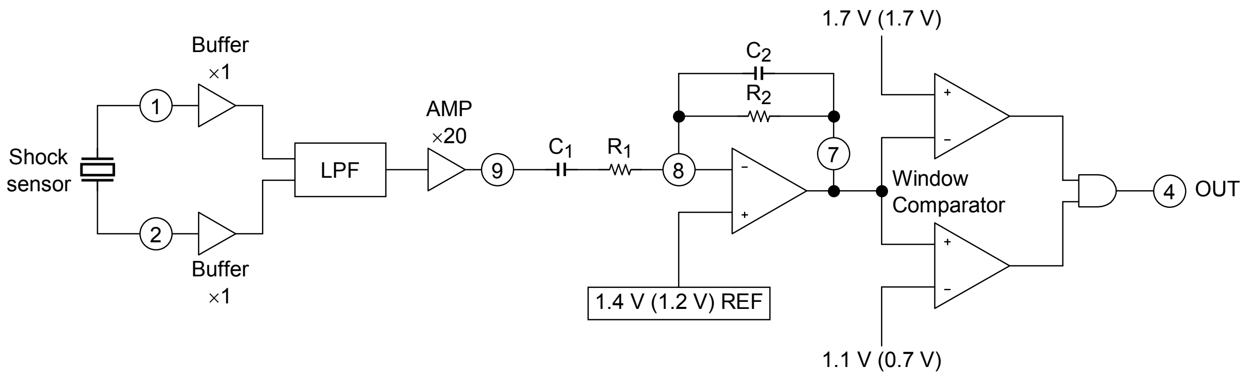


Figure 1 The Composition of G-Force Sense Amplifier

Figure 1 shows the configuration of G-Force sensor amplifier. The shock sensor is connected between the pins 1 and 2. External registor R_1 and R_2 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.

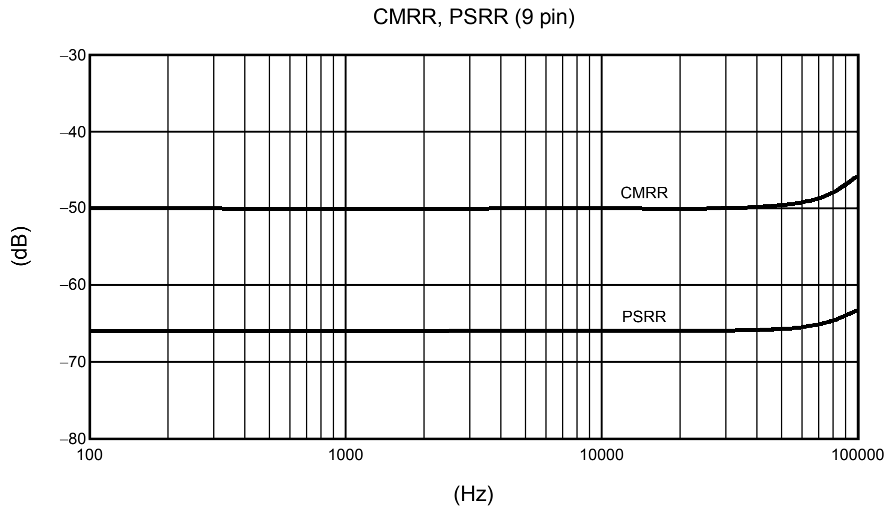
(gain setting) * 10 PIN → GND
500/(s × g) = G1
G1/20 = G (OP-AMP)

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

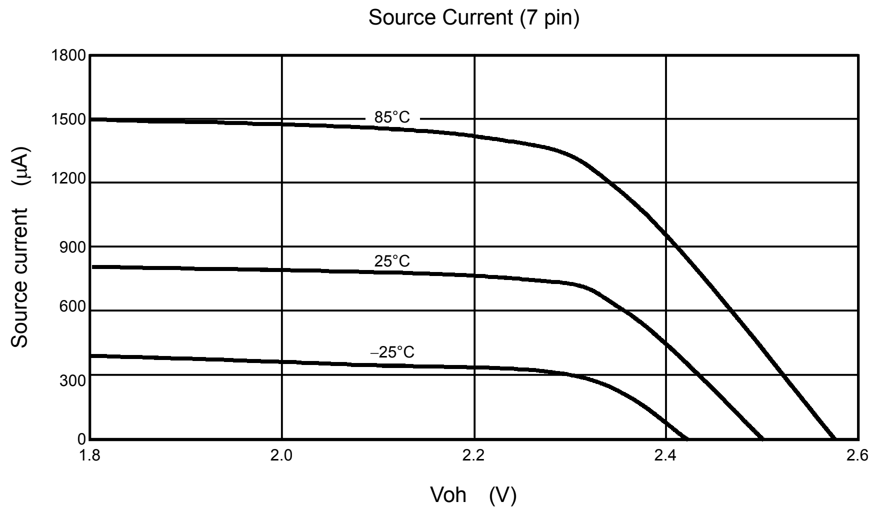
(LPF setting)
$fc = 1/(2 \pi \times R_2 \times C_2)$

Reference Data

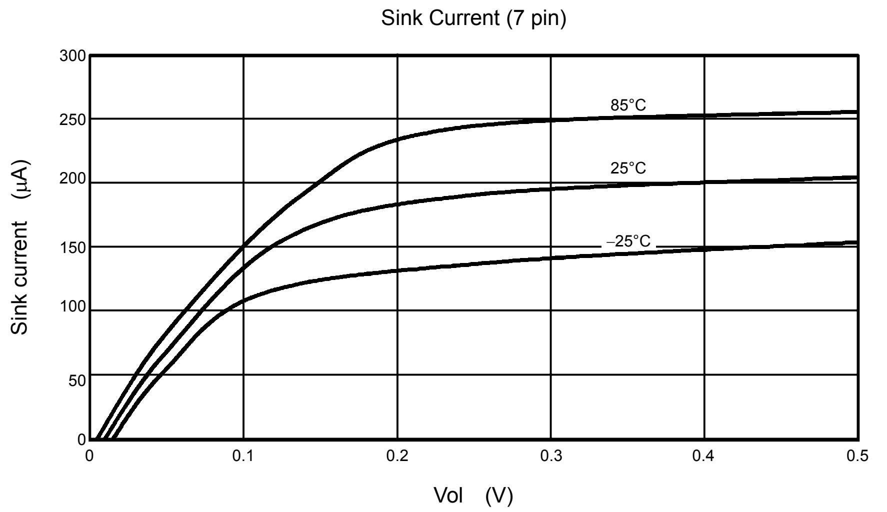
(1) 9 pin (DIFF-AMP output) CMRR, PSRR



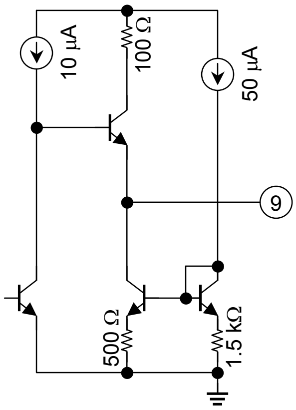
(2) 7 pin (OP-AMP output) source current

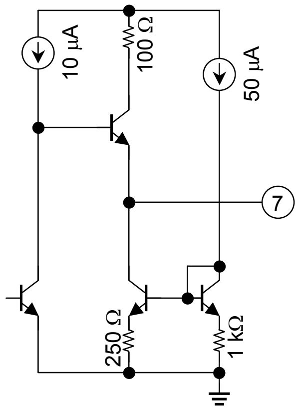


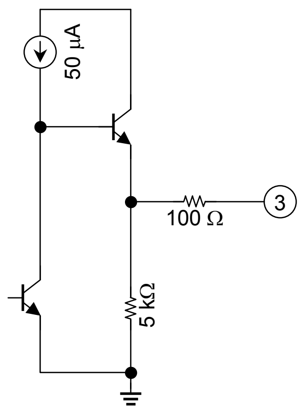
(3) 7 pin (OP-AMP output) sink current

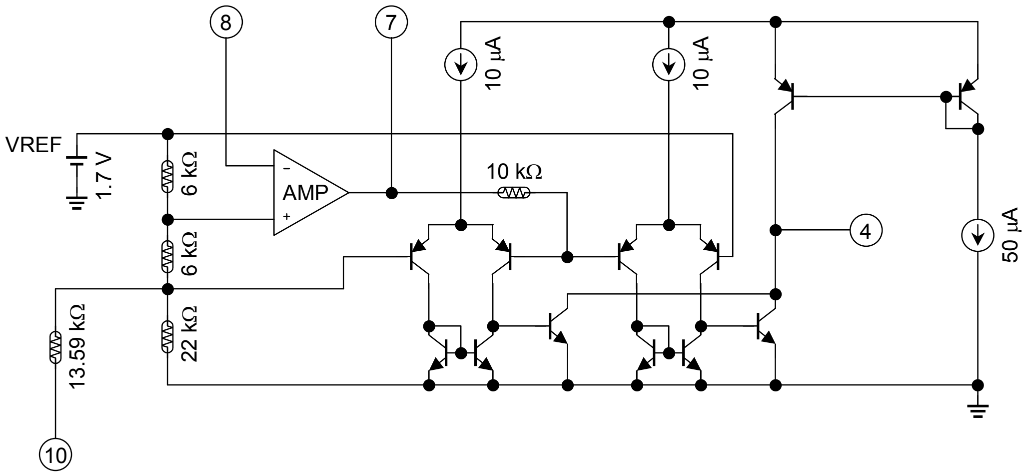


Equivalent Circuit



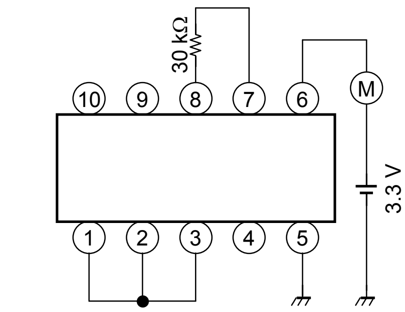




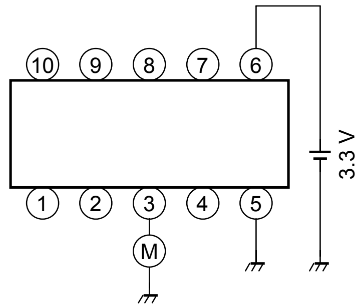


Test Circuit

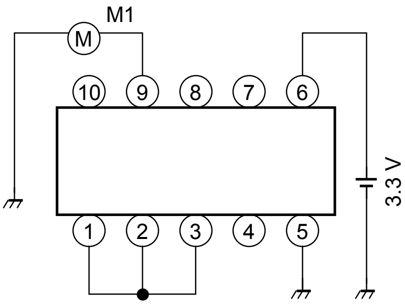
(1) Supply current ICC



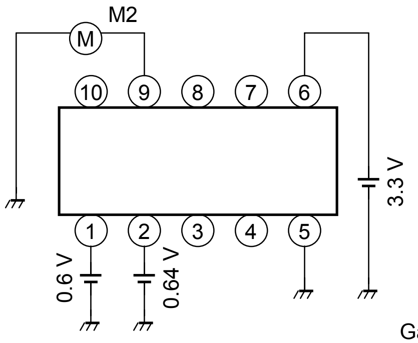
(2) GUARD Pin
Output voltage VoGur



(3) DIFF-AMP
Gain GvBuf
Step 1

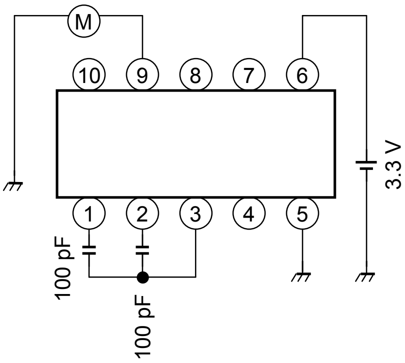


Step 2

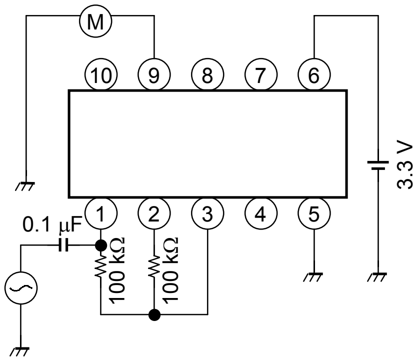


$$\text{Gain} = \frac{M2 - M1}{0.64 - 0.60}$$

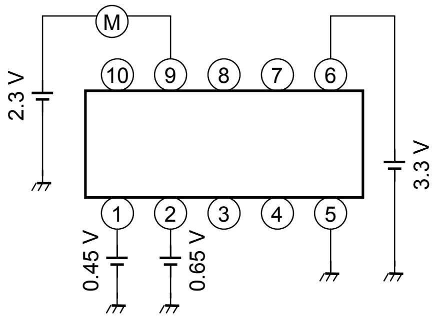
(4) DIFF-AMP
Output DC voltage VoBuf



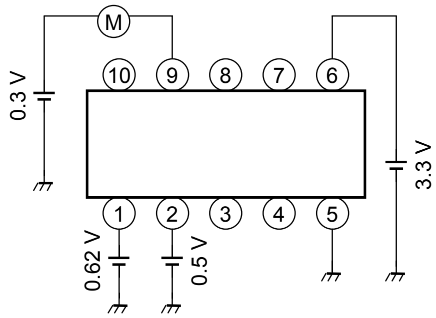
(5) DIFF-AMP
Low cut-off frequency fc



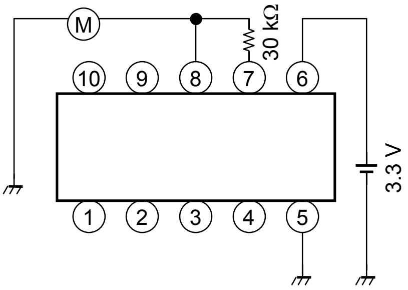
(6) DIFF-AMP
Output source current IBso



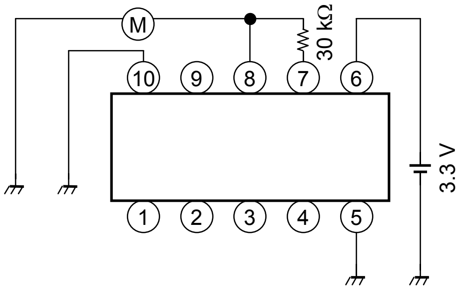
(7) DIFF-AMP
Output sink current IBsi



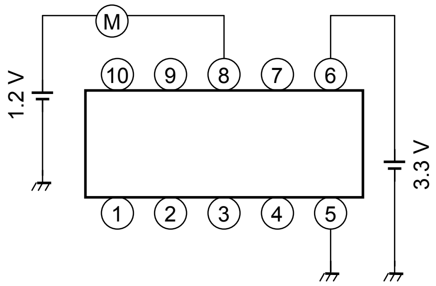
(8) OP-AMP
Input voltage 1 Vin1



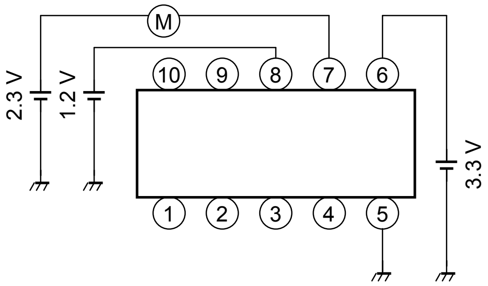
(9) OP-AMP
Input voltage 2 Vin2



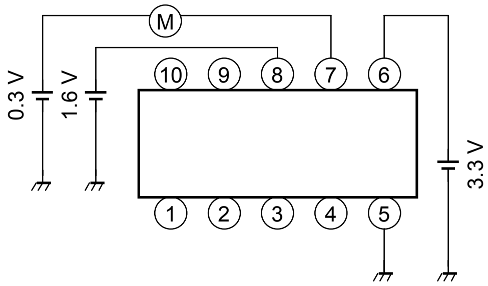
(10) OP-AMP
Input current I_{in}



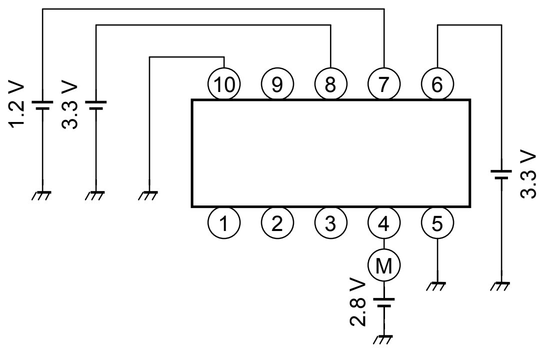
(11) OP-AMP
Output source current IAso



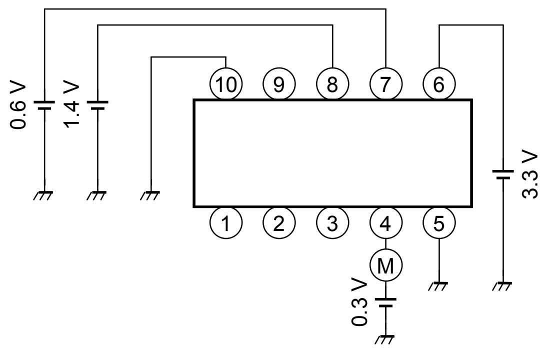
(12) OP-AMP
Output sink current IAsi



(13) Window comparator
Output source current IWso

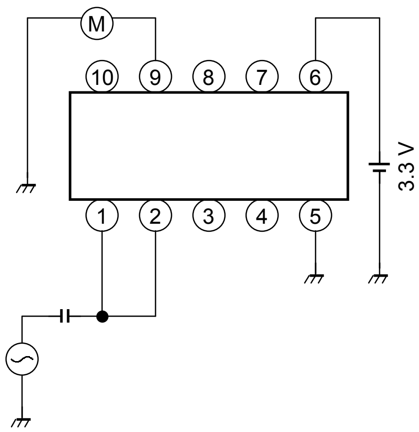


(14) Window comparator
Output sink current IWsi

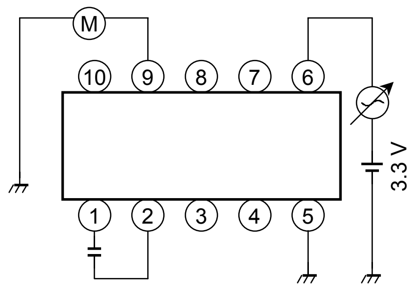


Test Circuit (for reference)

(a) DIFF-AMP
CMRR



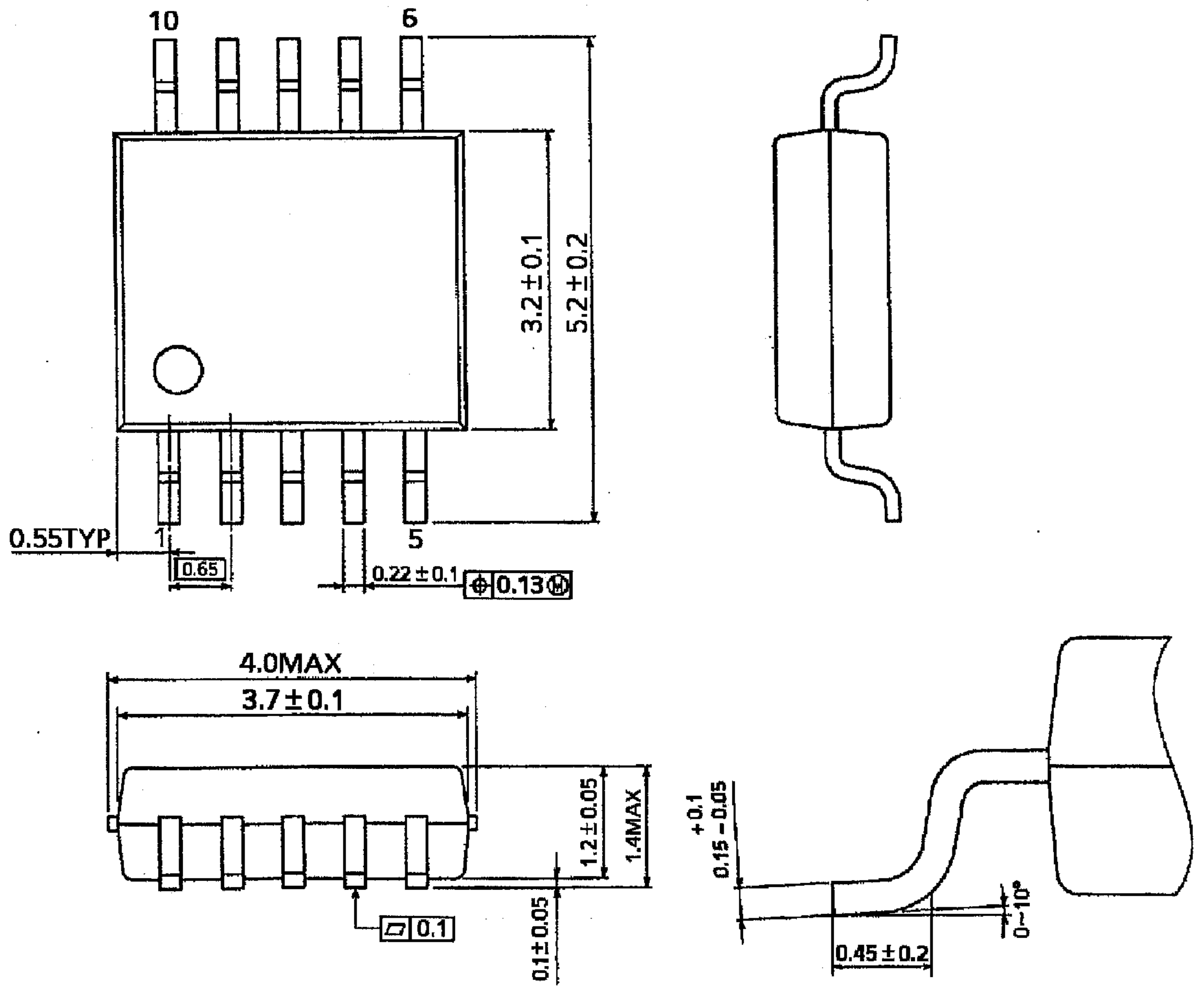
(b) DIFF-AMP
PSRR



Package Dimensions

SSOP10-P-0.65A

Unit : mm



Weight: 0.04 g (typ.)

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