

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

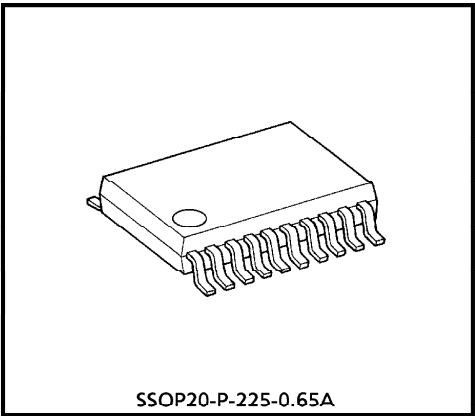
TA8553FN

G-FORCE SENSOR AMP IC

TA8553FN is a Bipolar Monolithic Integrated Circuit for use of G-Force Sensor Amp.  
This device detect G-Force by connect Sensor extenally.

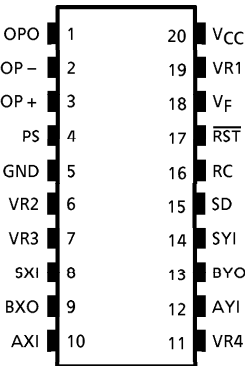
FEATURE

- Supply Voltage : +5V
- This device detect by external G-Force Sensor. And can detect both X-direction and Y-direction.
- This device could set follows,  
Total Gain  
Cut off Frequency
- This device include follows Block.  
Reference Voltage Circuit  
Reset Circuit  
Voltage Fault Detector  
Op-Amp
- Reference Voltage used Band-Gap Circuit and superior Temperature Characteristics.
- Powersave Mode is a Low Power Mode and act only Reference Circuit, Reset Circuit.
- Package : SSOP20-P-225A (0.65mm pitch)



Weight : 0.14g (Typ.)

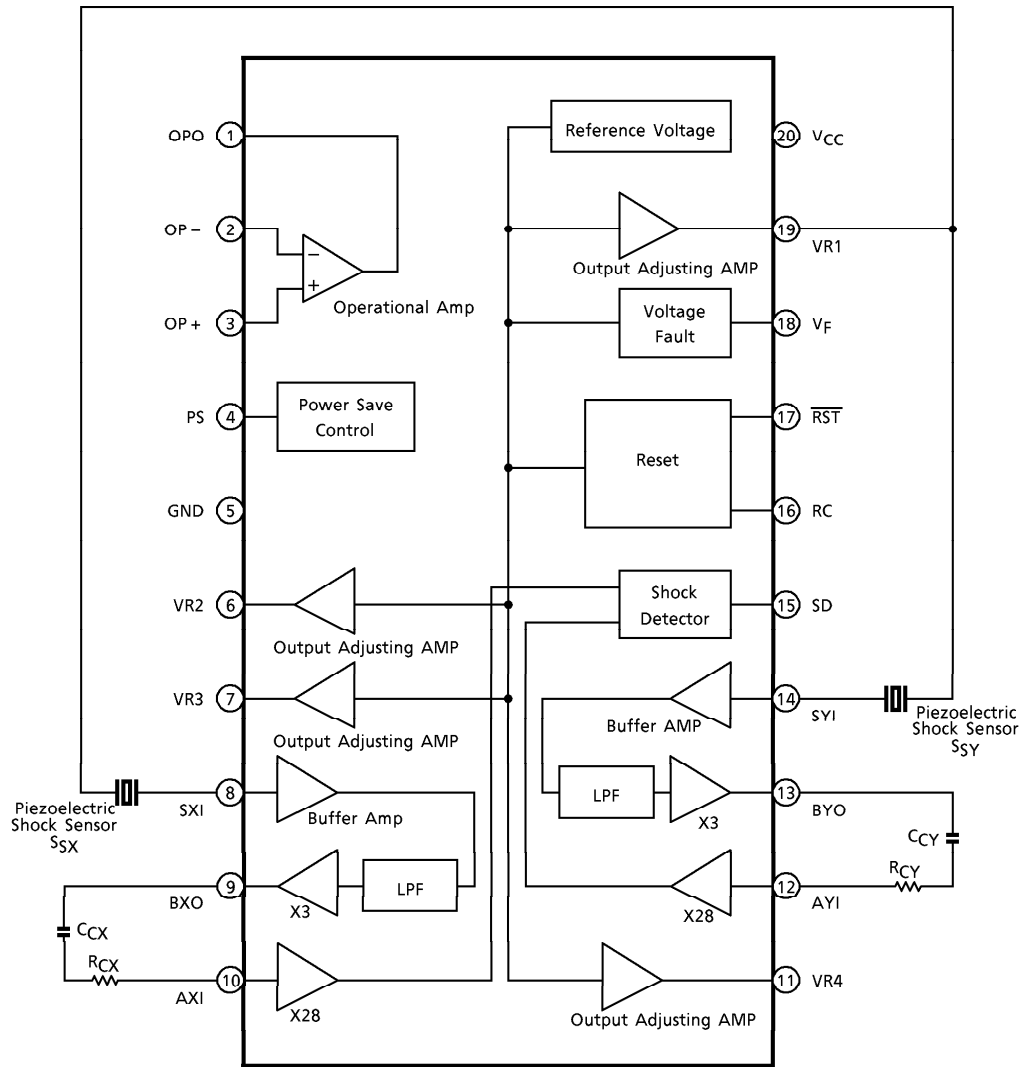
PIN CONNECTION (TOP VIEW)



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BLOCK DIAGRAM



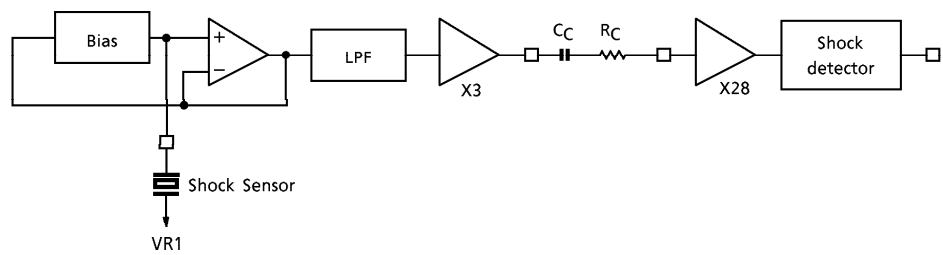
## PIN CONNECTION

Pin No.	PIN NAME	DESCRIPTION
1	OPO	Op-Amp Output
2	OP –	Op-Amp Input ( – )
3	OP +	Op-Amp Output ( + )
4	PS	Powersave Input (H : Powersave Mode)
5	GND	Ground
6	VR2	Reference Voltage 2 Output
7	VR3	Reference Voltage 3 Output
8	SXI	Output of X-direction Sensor Amp
9	BXO	LPF Output of X-direction Sensor
10	AXI	Input of 28 Multiplier for X-direction Sensor
11	VR4	Reference Voltage Output ( = 1/2 Voltage of VR1)
12	AYI	Input of 28 Multiplier for Y-direction Sensor
13	BYO	LPF Output of X-direction Sensor
14	SYI	Output of X-direction Sensor Amp
15	SD	Shock Detector Output (H : Shock being given)
16	RC	Reset Time Setting Terminal
17	RST	Reset Output (L : Reset active)
18	V <sub>F</sub>	Voltage Fault Detector Input (H : Voltage fault)
19	VR1	Reference Voltage Output
20	V <sub>CC</sub>	Supply Voltage

CIRCUIT OPERATION

1. Sensor Amp Block

The structure of Sensor Amp. Block is as follows. This block outputs "L" at SD terminal, if it detects shock signal from the shock sensor.



(1) The method of setting Cut-off frequency of high pass filter.

This filter's characteristics is defined by R<sub>C</sub>·C<sub>C</sub> Cut-off frequency f<sub>H</sub> are defined by the following equations.

$$f_H = \frac{1}{2 \cdot \pi \cdot C_C (R_C + 15000)} \quad (\text{Hz})$$

(2) The method of setting total gain.

Total gain is defined by R<sub>C</sub>. Gain G are defined by the following equation.

$$G = \frac{70 \times 15000}{15000 + R_C} \quad (\text{V} / \text{V})$$

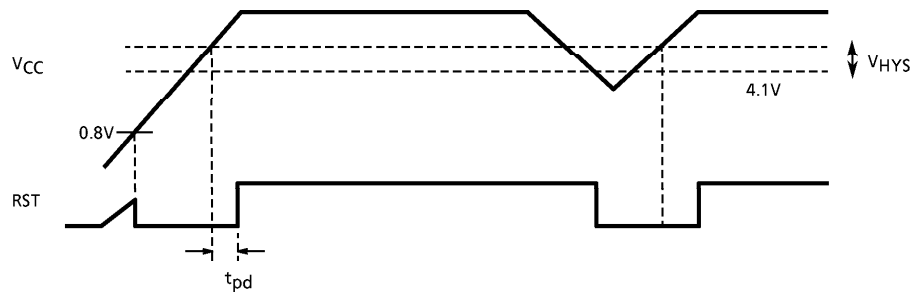
2. Reference Voltage Block

Reference Voltage Circuit built in this IC outputs the voltage shown in the following table. It is made of Band-gap circuit. So we can get thermally stable output.

Parameter	Output Voltage (typ value、Ta = 25°C)
VR1	3.20
VR2	4.00
VR3	0.80
VR4	1.60 (1 / 2 Voltage of VR1)

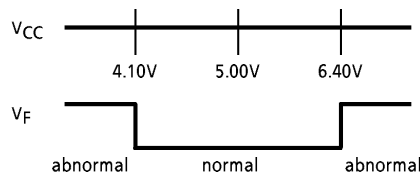
3. Reset Block

The function of Reset circuit is shown as follows.



4. Supply Voltage Fault Detection Block.

It outputs "H" at V<sub>F</sub> terminal in the case of detecting abnormal voltage.



5. Powersave Mode

To input "L" level signal at PS terminal. Powersave mode is active and this IC is put in lower power dissipation state. The terminals in the following table are in High-Impedance.

\* Output Terminals which is put in High Impedance in Powersave Mode.

PIN No.	TERMINAL
1	OPO
6	VR2
7	VR3
9	BXO
13	BYO
15	VR4
18	V <sub>F</sub>
19	VR1

**SPECIFICATION****1. Absolute Maximum Ratings (Ta = 25°C)**

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	$V_{CC}$	7	V
Input Voltage Range	$V_{IN}$	$-0.3 \sim V_{CC} + 0.3$	V
Power Dissipation	$P_D$	960	mW
Storage Temperature	$T_{stg}$	$-55 \sim 150$	°C

**2. Recommend Operating Conditions**

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	$V_{CC}$	$5V \pm 10\%$	V
Operating Temperature	$T_{opr}$	$-40 \sim 85$	°C

**ELECTRICAL CHARACTERISTICS (Unless Otherwise Noted  $V_{CC} = 5V$ ,  $T_a = 25^\circ C$ )****1. Supply Current**

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current (PWSV Mode)	$I_{CCS}$	1	PS = "H"	—	1.1	1.5	mA
Supply Current	$I_{CCD}$	1	PS = "L"	—	—	5	

**2. Powersave Input Block**

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Voltage	H Level	$V_{IH}$	—	3.0	—	—	V
	L Level	$V_{IL}$	—	—	—	1.4	
Threshold Voltage	$V_{TH}$	—	—	—	2.3	—	

**3. Sensor Detector****(1) BUFFER / LPF Block**

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Impedance	$Z_{IN}$	—	—	30	45	60	$M\Omega$
LPF Cut-off Frequency	$f_c$	2	-3dB	5	8.3	11.6	kHz
Output Impedance	$Z_{out}$	—	—	—	—	500	$\Omega$
Gain	$G_V$	2	—	—	9.0	—	dB
Voltage Drop VR1 – SX1 (SY1)	VR1 – SX1 (SY1)	—	—	-0.6	—	0.6	V

## (2) AMP / SHOCK Detector Block

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
AMP GAIN	$G_V$	—	—	—	28.5	—	dB
Input Impedance	$Z_{IN}$	—	—	12	15	18	$k\Omega$
Minimum Detected Voltage Range Converted into Input	$\Delta V_{INp-p}$	3	Buffer Amp : $V_{IN} = 1\text{KHz}$	12	—	20	$mV_{p-p}$
Shock Detecting Time	$t_{SD}$	—	SD Out : Open $V_{IN} = 50\text{mV}$ $f = 1\text{kHz}$	—	—	1	$\mu s$
Output Sink Current	$I_{sink}$	—	—	0.5	—	—	mA
Output Source Current	$I_{source}$	—	—	—	50	—	$\mu A$

## 4. Reference Voltage Block

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
VR1 Output Voltage	VR1	4	—	3.08	3.20	3.32	V
VR2 Output Voltage	VR2	4	—	3.85	4.00	4.15	
VR3 Output Voltage	VR3	4	—	0.77	0.80	0.83	
VR4 Output Voltage	VR4	4	—	1.54	1.60	1.66	
VR1 Output Source Current	$I_{source1}$	5	—	5	—	—	mA
VR2 Output Source Current	$I_{source2}$	5	—	1	—	—	
VR3 Output Source Current	$I_{source3}$	5	—	—	100	—	$\mu A$
VR4 Output Source Current	$I_{source4}$	5	—	3	—	—	mA
VR1, 2 Output Sink Current	$I_{sink1, 2}$	6	—	—	100	—	$\mu A$
VR3 Output Sink Current	$I_{sink3}$	6	—	2	—	—	mA
VR4 Output Sink Current	$I_{sink4}$	6	—	3	—	—	
Temperature Variation of Output Voltage	$\Delta V_{out}$	—	—	—	—	$\pm 100$	PPM / $^{\circ}\text{C}$
VR1 / VR2 / VR3 / VR4 Relative Accuracy of Output Voltage	$\Delta V_R$	—	—	—	—	$\pm 1$	%

## 5. Reset Block

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reset Detecting Supply Voltage	$V_{RST}$	7	—	3.90	4.10	4.30	V
Delay Time	$D_T$	—	$C_{RC} = 0.1\mu F$	60	100	150	ms
Lower Limit Supply Voltage on Operation	$V_{min}$	—	—	—	—	0.8	V
Sink Current	$I_{sink}$	8	$V_{OL} = 0.4V$	2	—	—	mA
Source Current	$I_{source}$	9	$V_{OH} = 4V$	—	1	—	mA
Hysteresis Voltage	$V_{hys}$	—	—	50	100	150	mV
Response Time	$T_{pd}$	—	Output : Open	—	2	5	$\mu s$

## 6. Power Supply Voltage Fault Detection

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
L-Level Detection Voltage	$V_F(L)$	10	—	4.00	4.20	4.40	V
H-Level Detection Voltage	$V_F(H)$	10	—	6.00	6.30	6.60	
Sink Current	$I_{sink}$	11	$V_{OL} = 0.4V$	0.50	—	—	mA
Source Current	$I_{source}$	12	$V_{OH} = 4V$	0.50	—	—	
Difference between L-Level Detection Voltage and Reset Detection Voltage	$\Delta V$ ( $V_F - V_{RST}$ )	—	—	—	0.10	—	V
Response Time	$t_F$	—	Output : Open	—	2	5	$\mu s$

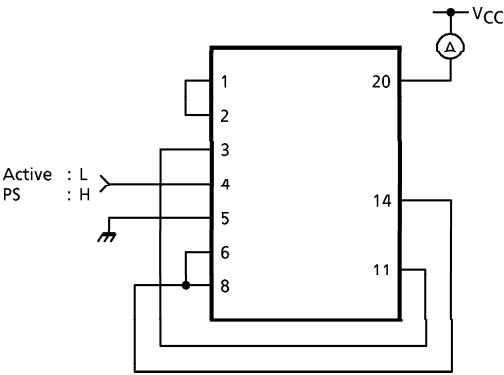
## 7. Operational Amplifier

PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Voltage Range	$V_{IN}$	13	—	0	—	$V_{CC} - 1.6$	V
Output Voltage	$V_{OUT}$	13	—	0.4	—	$V_{CC} - 1.6$	
Input Offset Voltage	$V_{IO}$	—	—	—	$\pm 1$	$\pm 5$	mV
Input Bias Current	$I_I$	—	—	—	100	300	nA
Output Source Current	$I_{source}$	—	—	5	—	—	mA
Output Sink Current	$I_{sink}$	—	—	3	—	—	
Slew Rate	$S_R$	—	—	0.1	0.3	—	V / $\mu s$

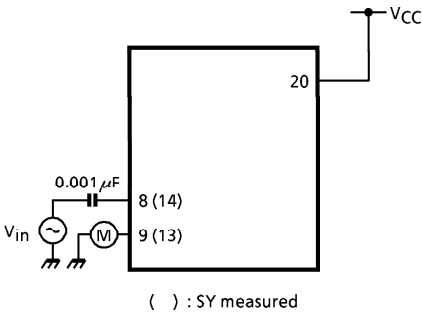


TEST CIRCUIT

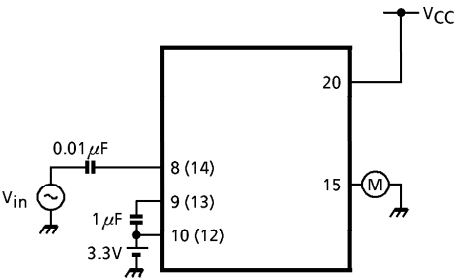
① Supply Current



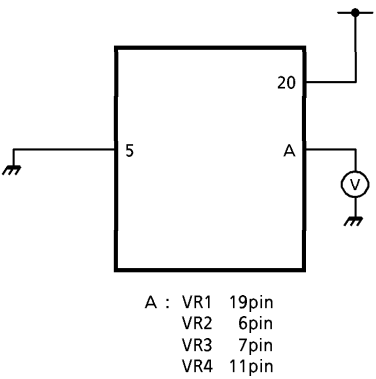
② AMP Gain, LPF Cut off Frequency



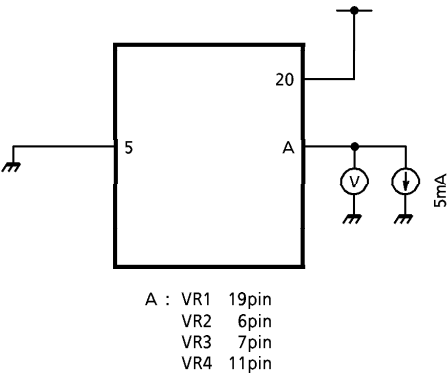
③ Minimum Detected Voltage Range  
Converted into Input



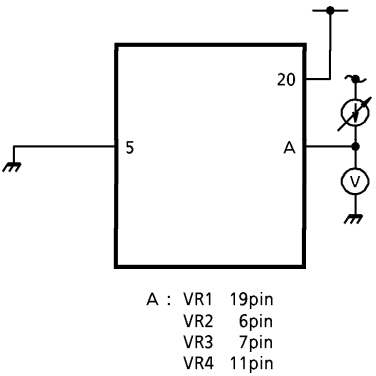
④ Reference Voltage



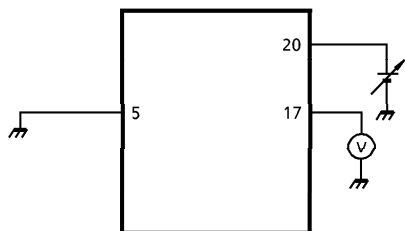
⑤ Reference voltage circuit Output source  
current



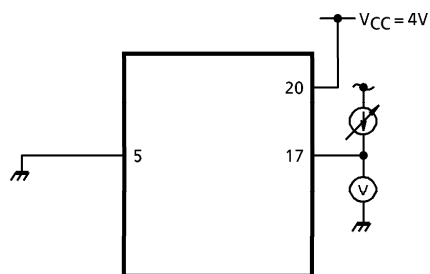
⑥ Reference circuit output sink current



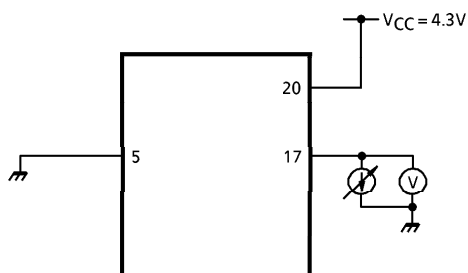
⑦ Reset Detecting Voltage



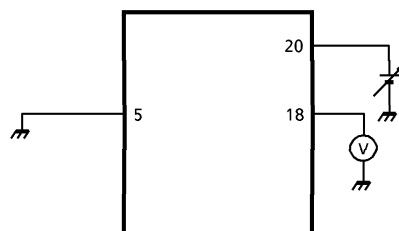
⑧ Reset circuit output sink current



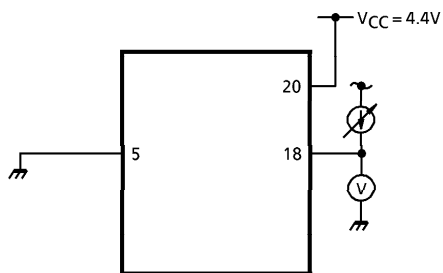
⑨ Reset circuit output source current



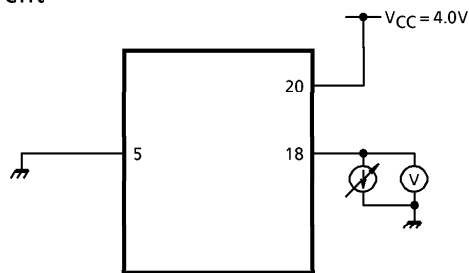
⑩ Voltage Fault Detection output voltage



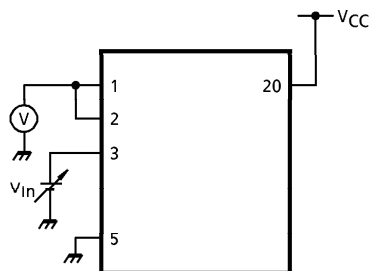
⑪ Voltage Fault Detection output sink current



⑫ Voltage Fault Detection output source current



⑬ Op-Amp Input voltage Range



## USAGE PRECAUTIONS

### 1. Processing of shock sensor signal input pins (pins 8 and 16)

Pins 8 and 16 of the device are high-impedance input pins. Therefore, pay careful attention not to cause leakage from these to other pins. Leakage from these pins could cause the device to operate erratically.

Also, make sure that the sensor and the device are connected in the shortest distance possible.

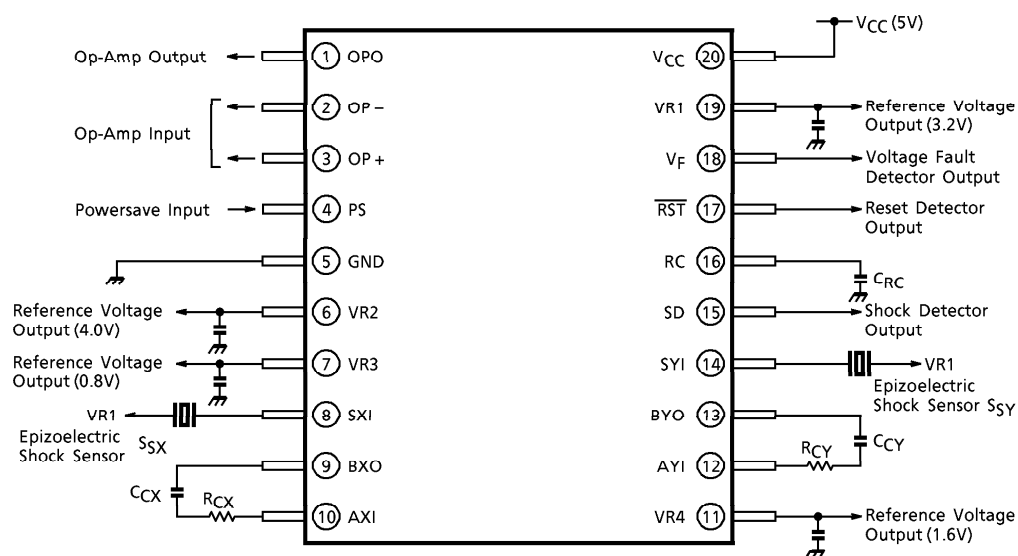
### 2. About $V_{CC}$ and GND

Make sure that  $V_{CC}$  and GND are as wide as possible. Insert the power supply-to-GND bypass capacitor near the device.

### 3. About the sensor used

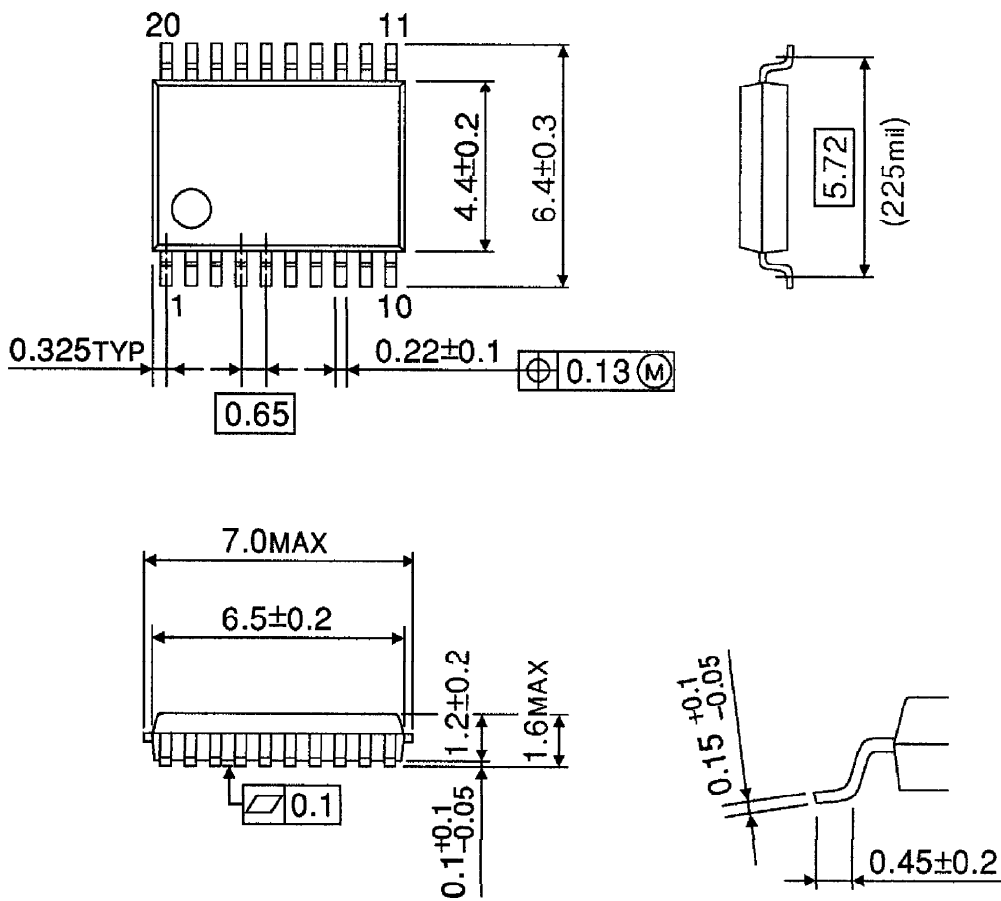
Before using a sensor connected external to the chip, carefully check it to see that its characteristics suit the device.

## APPLICATION CIRCUIT



PACKAGE  
SSOP20-P-225-0.65A

UNIT : mm



Weight : 0.14g (Typ.)