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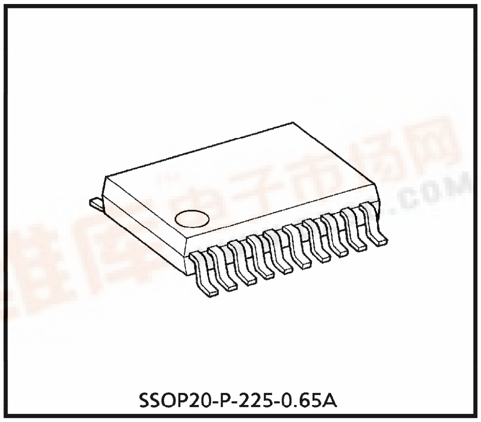
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT　SILICON MONOLITHIC

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.



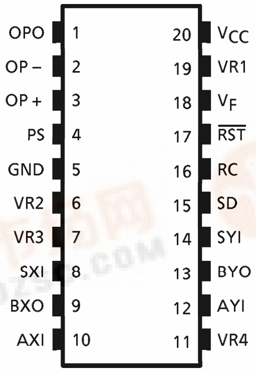
SSOP20-P-225-0.65A

Weight : 0.14g (Typ.)

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)

PIN CONNECTION (TOP VIEW)



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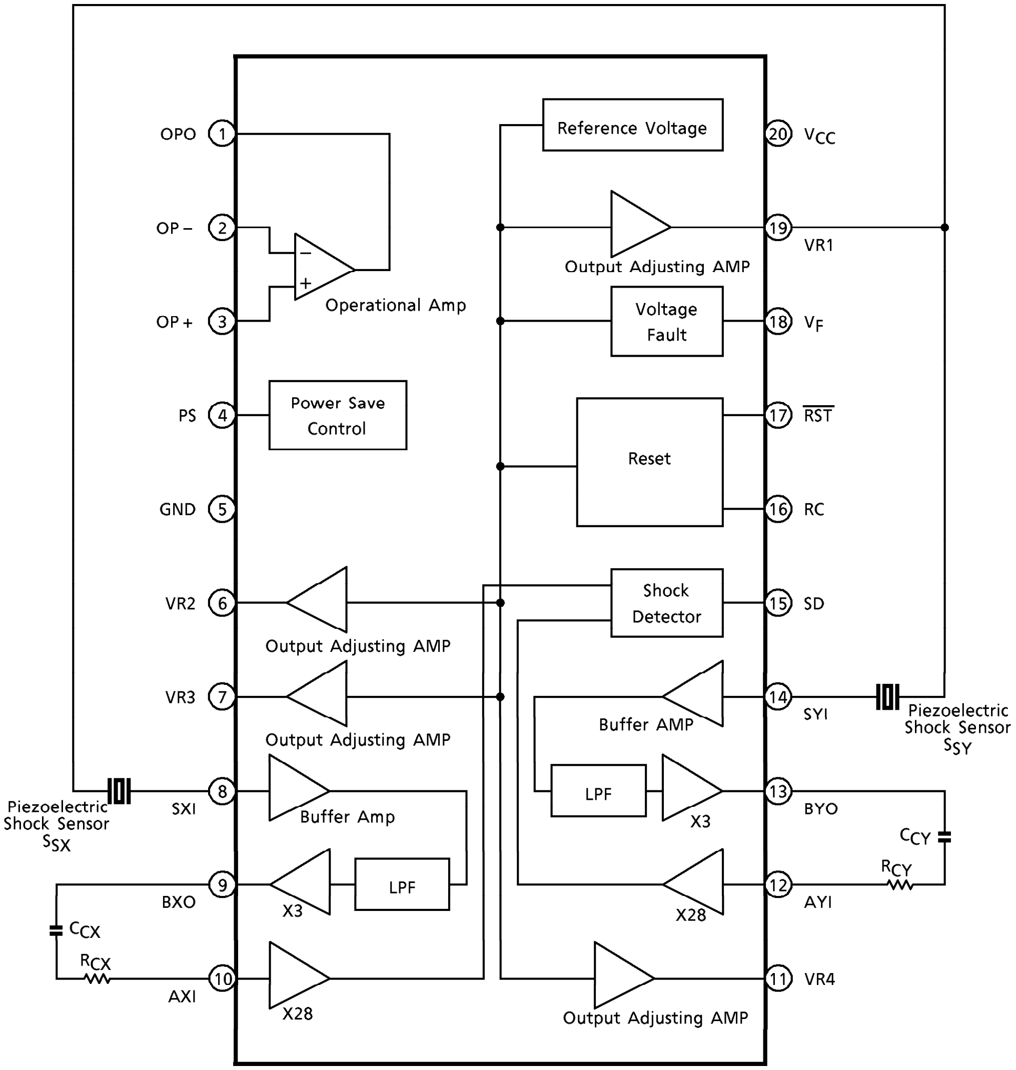
BLOCK DIAGRAM



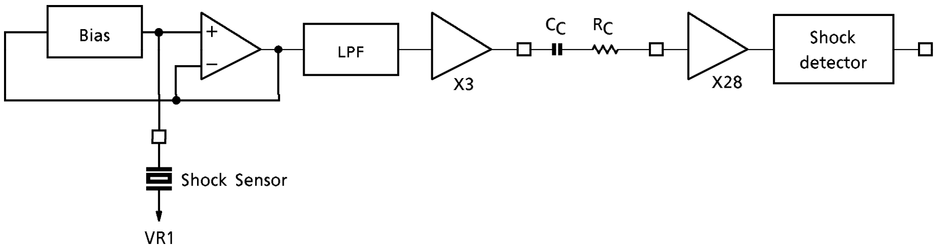
PIN CONNECTION

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 Multiplicator for X-direction Sensor
11	VR4	Reference Voltage Output (= 1/2 Voltage of VR1)
12	AYI	Input of 28 Multiplicator 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	$\overline{\text{RST}}$	Reset Output (L : Reset active)
18	V_F	Voltage Fault Detector Input (H : Voltage fault)
19	VR1	Reference Voltage Output
20	V_{CC}	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 $R_C \cdot C_C$ Cut-off frequency f_H are defined by the following equations.

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

(2) The method of setting total gain.

Total gain is defined by R_C. Gain G are defined by the following equation.

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

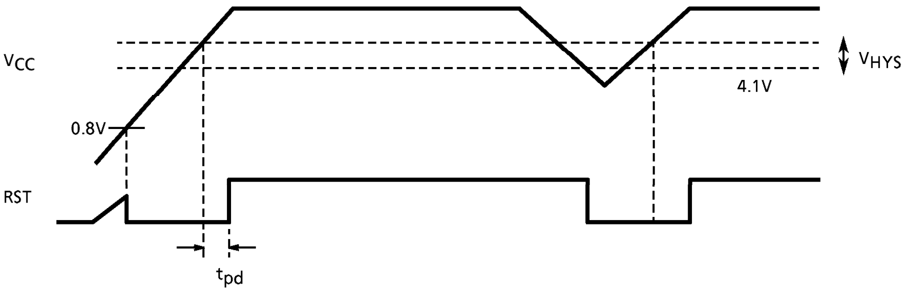
2. Reference Voltage Block

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)

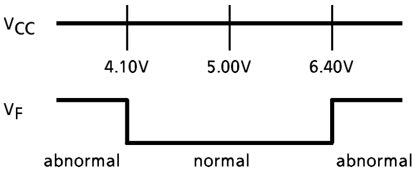
3. Reset Block

   The function of Reset circuit is shown as follows.



4. Supply Voltage Fault Detection Block.

   It outputs "H" at V_F 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_F
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 ± 10%	V
Operating Temperature	T_{opr}	$-40 \sim 85$	°C

ELECTRICAL CHARACTERISTICS (Unless Otherwise Noted $V_{CC} = 5V$、Ta = 25°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	MΩ
LPF Cut-off Frequency	f_c	2	−3dB	5	8.3	11.6	kHz
Output Impedance	Z_{out}	—	—	—	—	500	Ω
Gain	G_V	2	—	—	9.0	—	dB
Voltage Drop VR1 − SXI (SYI)	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	kΩ
Minimum Detected Voltage Range Converted into Input	$\Delta V_{INp\text{-}p}$	3	Buffer Amp : V_{IN} = 1KHz	12	—	20	$mV_{p\text{-}p}$
Shock Detecting Time	t_{SD}	—	SD Out : Open V_{IN} = 50mV f = 1kHz	—	—	1	μs
Output Sink Current	I_{sink}	—	—	0.5	—	—	mA
Output Source Current	I_{source}	—	—	—	50	—	μA

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	—	μA
VR4 Output Source Current	$I_{source4}$	5	—	3	—	—	mA
VR1, 2 Output Sink Current	$I_{sink1,\ 2}$	6	—	—	100	—	μA
VR3 Output Sink Current	I_{sink3}	6	—	2	—	—	mA
VR4 Output Sink Current	I_{sink4}	6	—	3	—	—	
Temperature Variation of Output Voltage	ΔV_{out}	—	—	—	—	± 100	PPM / °C
VR1 / VR2 / VR3 / VR4 Relative Accuracy of Output Voltage	ΔV_R	—	—	—	—	± 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	μs

6. Power Supply Voltage Fault Detection

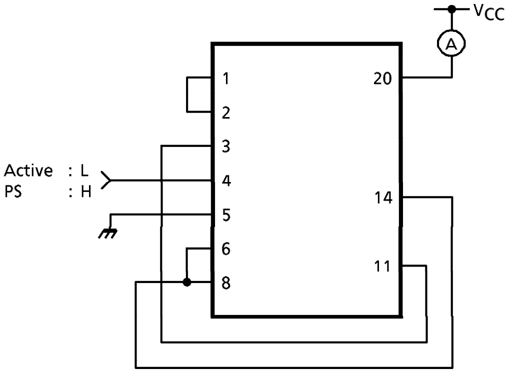
PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
L-Level Detection Voltage	$V_{F(L)}$	10	—	4.00	4.20	4.40	V
H-Level Detection Voltage	$V_{F(H)}$	10	—	6.00	6.30	6.60	
Sink Current	I_{sink}	11	$V_{OL} = 0.4V$	0.50	—	—	mA
Source Current	I_{source}	12	$V_{OH} = 4V$	0.50	—	—	
Difference between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

7. Operational Amplifier

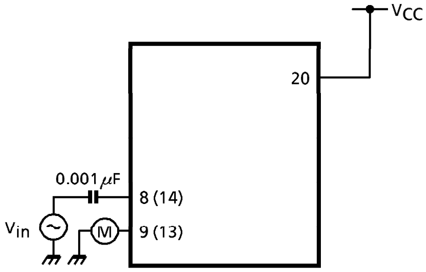
PARAMETER	SYMBOL	TEST NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Voltage Range	V_{IN}	13	—	0	—	$V_{CC} - 1.6$	V
Output Voltage	V_{OUT}	13	—	0.4	—	$V_{CC} - 1.6$	
Input Offset Voltage	V_{IO}	—	—	—	±1	±5	mV
Input Bias Current	I_I	—	—	—	100	300	nA
Output Source Current	I_{source}	—	—	5	—	—	mA
Output Sink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

TEST CIRCUIT

① Supply Current

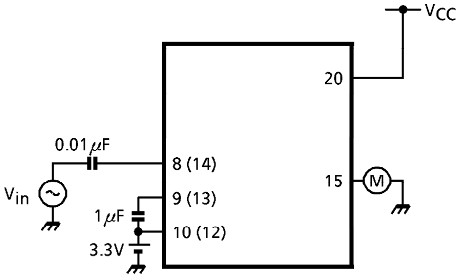


② AMP Gain, LPF Cut off Frequency

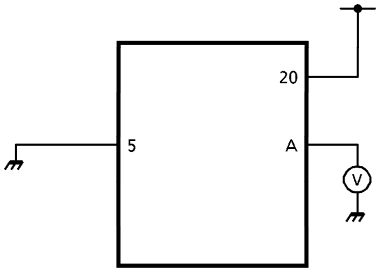


( ) : SY measured

③ Minimum Detected Voltage Range Converted into Input

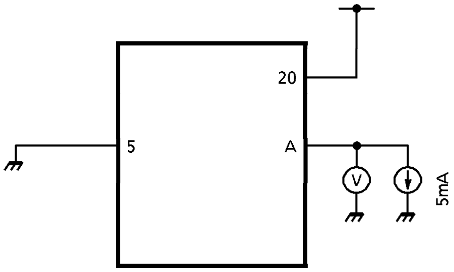


④ Reference Voltage



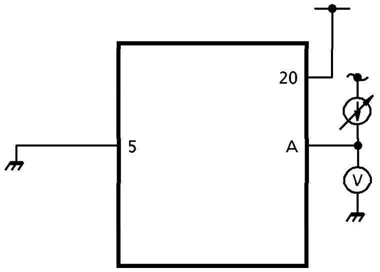
A : VR1 19pin
VR2 6pin
VR3 7pin
VR4 11pin

⑤ Reference voltage circuit Output source current



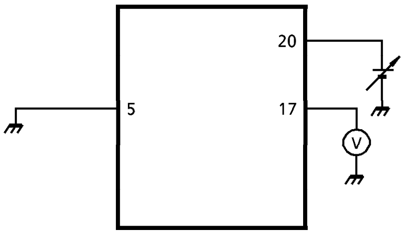
A : VR1 19pin
VR2 6pin
VR3 7pin
VR4 11pin

⑥ Reference circuit output sink current

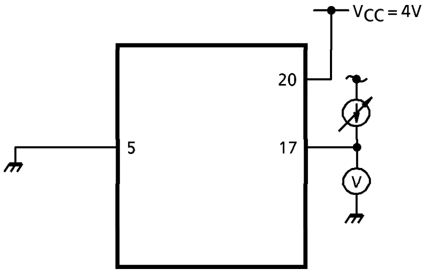


A : VR1 19pin
VR2 6pin
VR3 7pin
VR4 11pin

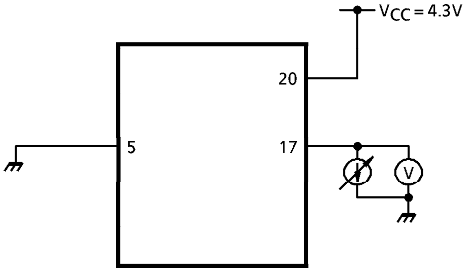
⑦ Reset Detecting Voltage



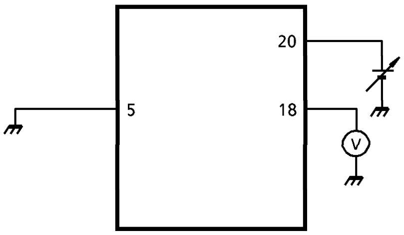
⑧ Reset circuit output sink current



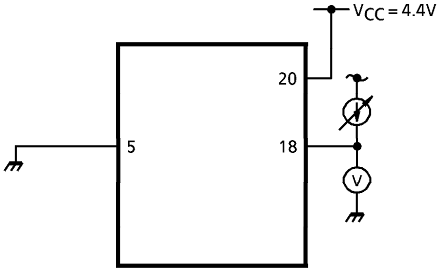
⑨ Reset circuit output source current



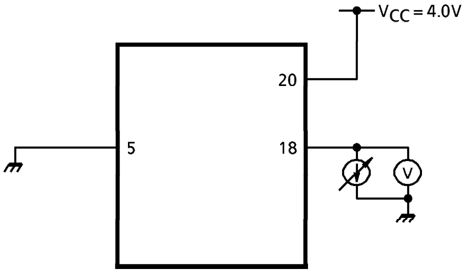
⑩ Voltage Fault Detection output voltage



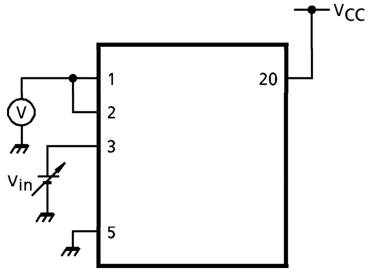
⑪ Voltage Fault Detection output sink current



⑫ Voltage Fault Detection output source current



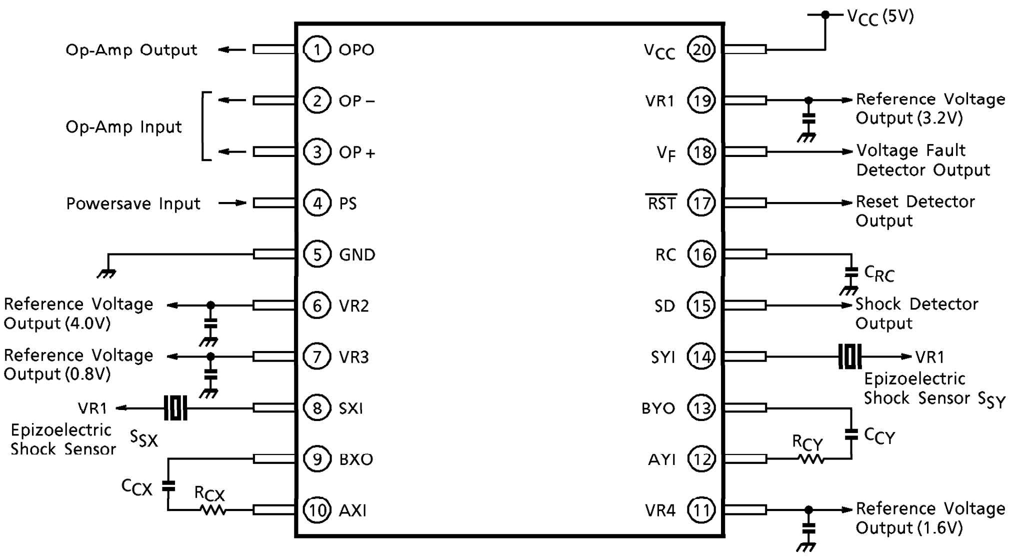
⑬ Op-Amp Input voltage Range



USAGE PRECAUTIONS

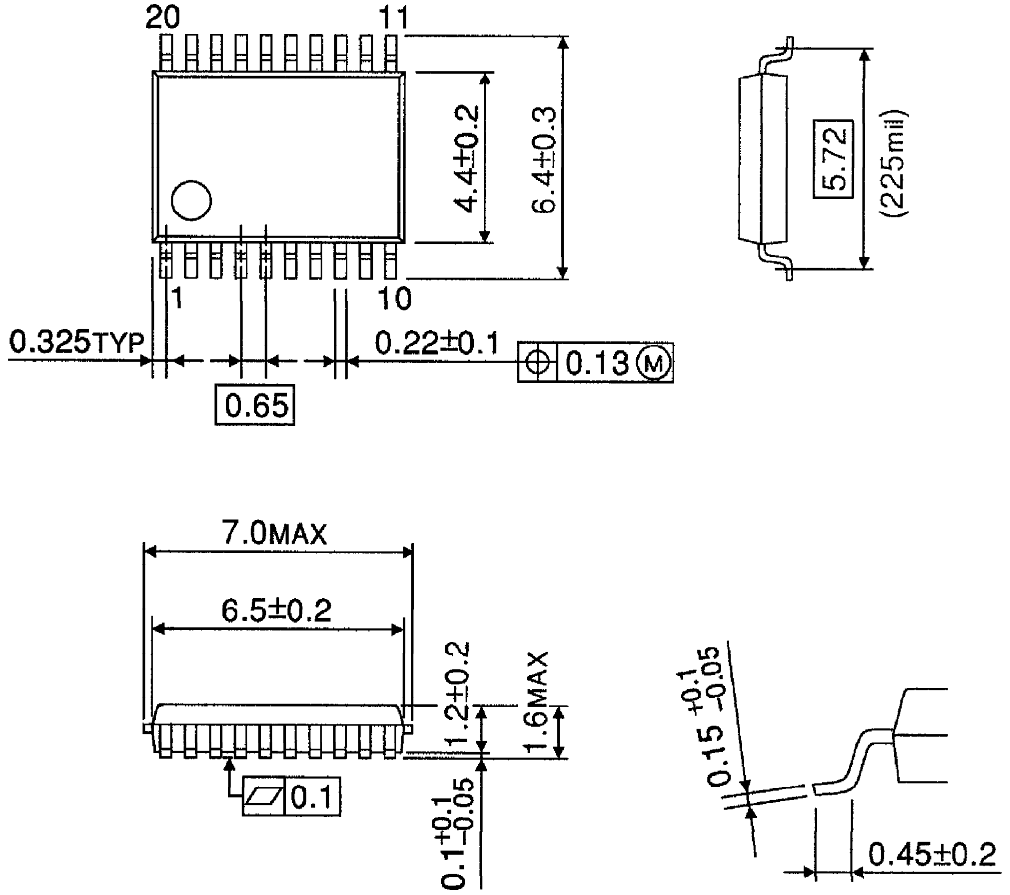
1. Processing of shock sensor signal input pins (pins 8 and 16)
   Pins 8 and 16 of the device are high-impedance input pins. Therefore, pay careful attention not to cause leakage from these to other pins. Leakage from these pins could cause the device to operate erratically.
   Also, make sure that 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



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