

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

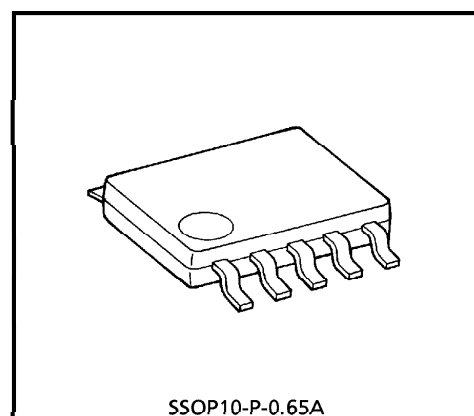
TA8578FN

SHOCK SENSOR IC (1ch VERSION)

TA8578FN detects an existence of external shock through the shock sensor and outputs.

FEATURES

- TA8578FN operates from 5VDC single power supply voltage.
- Signal from the shock sensor is amplified according to setting gain, and is detected through the internal window comparator.
- TA8578FN incorporates 1-ch shock detecting circuitry.
- Input terminal of sensor signal is designed high impedance.
Input impedance = $50M\Omega$ (Typ.)
- LPF (Low Pass Filter) circuitry is incorporated.
Cut off frequency of LPF = 7kHz
- Sensitivity of shock detection can be adjusted by external devices.
- TA8578FN is designed for low power dissipation.
Active mode (Pin 3 : 5V) 2mA (Typ.)
Power-save mode (Pin 3 : 0V) $1.0\mu A$ (Typ.)
- Small package
SSOP10-P-0.65A (0.65mm pitch)

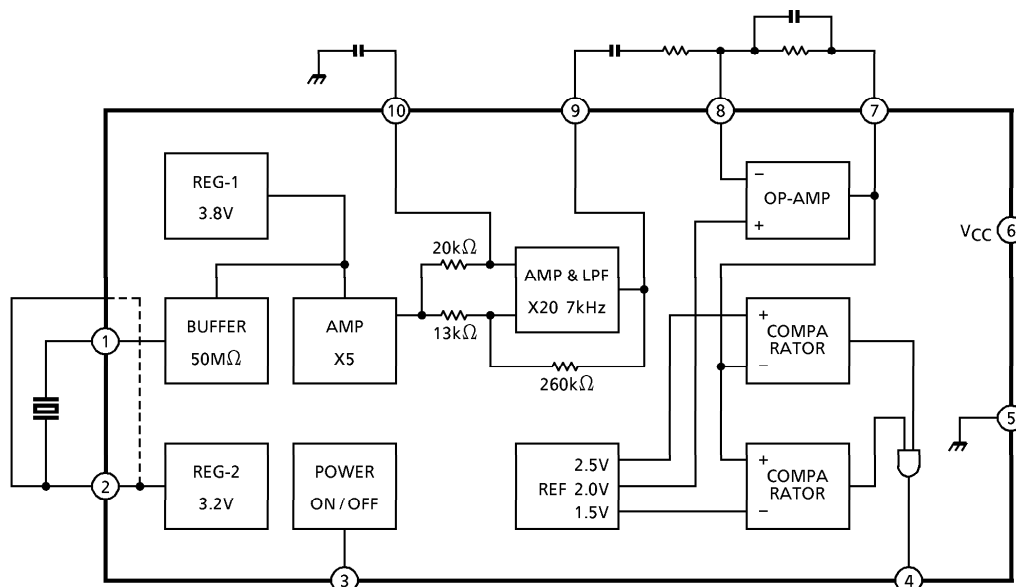


SSOP10-P-0.65A
Weight : 0.04g (Typ.)

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BLOCK DIAGRAM



PIN FUNCTION

PIN No.	PIN NAME	FUNCTION
1	SI	Connection terminal of shock sensor (Positive Polarity side)
2	VR	Connection terminal of shock sensor (Reference voltage = 3.2V)
3	PS	Power-save control terminal (0V input = Power-save mode, 5V input = active mode)
4	OUT	Output terminal (Active low : Output = "L" when shock is detected.)
5	GND	Ground terminal
6	VCC	Power supply voltage
7	BO	Op-Amp output terminal
8	BI	Op-Amp input terminal
9	AO	x100 (100 times) amplifier's output terminal
10	BYP	Connection terminal of external capacitance to set x20 (20 times) amplifier's gain. In no connection case, gain of internal Amp decreases to x5 (5 times) Amp.

MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$)

CHARACTERISTICS	SYMBOL	RATINGS	UNIT
Power Supply Voltage	V_{CC}	7	V
Input Voltage to PS Terminal	V_{IN}	$-0.3 \sim V_{CC} + 0.3$	V
Power Dissipation	P_D	300	mW
Storage Temperature	T_{stg}	$-55 \sim 150$	$^\circ\text{C}$

RECOMMEND OPERATING CONDITION

CHARACTERISTICS	SYMBOL	RATINGS	UNIT
Power Supply Voltage	V_{CC}	4.2~5.5	V
Operating Temperature	T_{OPR}	$-25 \sim 85$	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS (1) (Unless Otherwise Specified, $V_{CC} = 5\text{V}$, $T_a = 25^\circ\text{C}$)

*: Marked parameters are reference data.

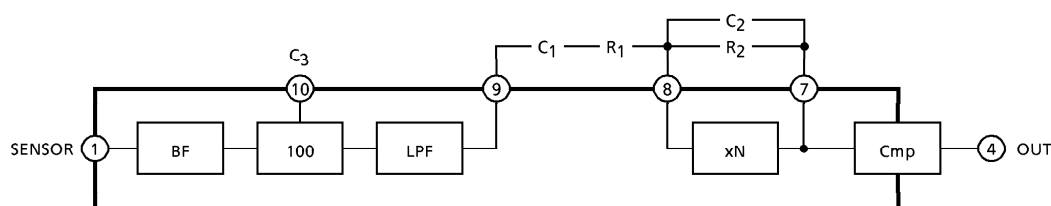
CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	—		4.2	—	5.5	V
Supply Current (In active mode)	I_{CCD}	—	Pin 3 (PS) = 5V	—	2	2.6	mA
Supply Current (In PS mode)	I_{CCS}	—	Pin 3 (PS) = 0V	—	0.1	1.0	μA
(REGULATOR)							
Output Voltage	V_{ref}	—	Pin 2 (VR)	3.1	3.25	3.4	V
Variation Level of Pin2 (VR)	ΔV_{ref}	—	$I_{source} = -200\mu\text{A}$	—	-30	-60	mV
(INPUT BUFFER)							
* Input Impedance	Z_{in}	—	Pin 1 (SI)	30	50	—	$\text{M}\Omega$
Different Voltage drop between SI and VR	$V_R - SI$	—	$T_a = -25 \sim 85^\circ\text{C}$ Voltage $ (V_R) - (SI) $	-200	—	200	mV

ELECTRICAL CHARACTERISTICS (2) (Unless Otherwise Specified, $V_{CC} = 5V$, $T_a = 25^\circ C$)

* : Marked parameters are reference data.

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
(No.9 PIN)							
* Gain of Internal $\times 100$ AMP	G_{V1}	—		39	40	41	dB
Internal LPF Cut-off Frequency	f_c	—		5	7	10	kHz
H Level Output Voltage	V_{oh}	—	$I_{source} = -0.6mA$	$V_{CC} - 1$	$V_{CC} - 0.9$	—	V
L Level Output Voltage	V_{ol}	—	$I_{sink} = 100\mu A$	—	0.1	0.6	V
(No.10 PIN)							
Internal Impedance	Z_{10}	—		16	20	24	$k\Omega$
(Op-Amp)							
* Op-Amp f_T	f_T	—		—	1.5	—	MHz
* DC Gain	G_{V2}	—		80	90	—	dB
* (+) Input Voltage	V_{IN+}	—		1.9	2	2.1	V
Input Current	I_{IN}	—		—	-35	-80	nA
* Offset Voltage	V_{off}	—		-7	0	7	mV
H Level Output Voltage	$V_{oh} (amp)$	—	$I_{source} = -0.6mA$	$V_{CC} - 1$	$V_{CC} - 0.9$	—	V
L Level Output Voltage	$V_{ol} (amp)$	—	$I_{sink} = 50\mu A$	—	0.1	0.6	V
(COMPARATOR & 4PIN)							
* Trip Voltage	V_{trp}	—	To compare with $V_{in} (+)$	± 0.45	± 0.5	± 0.55	V
H Level Output Voltage	$V_{oh} (cmp)$	—	$I_{source} = -35\mu A$	$V_{CC} - 1$	$V_{CC} - 0.5$	—	V
L Level Output Voltage	$V_{ol} (cmp)$	—	$I_{sink} = 0.6mA$	—	0.15	0.3	V
(3PIN)							
H Level Input Voltage	V_{IH}	—		3.0	—	—	V
L Level Input Voltage	V_{IL}	—	$I_{CC} < 1.0\mu A$	—	—	1.0	V

APPLICATION NOTE



C_1, R_1 : to design an external HPF.

R_1, R_2 : to determine the OpAmp Gain (xN).

R_2, C_2 : to design an external LPF.

C_3 : to design an internal HPF with internal Resistor 20k Ω .

In no connection case, Gain of internal Amp decreases to
 $\times 5$ (five-times) Amp.

- Method of the external parts setting :

When G-force Sensor (Sensor sensibility = n (mV / G), Sensor capacitance = a (pF)) is used to detect external shock of c (G), the external parts are determined as following ;

(Gain setting)

$$500 / (n \times c) = g \text{ [times]}$$

$$g / 100 = g \text{ (OpAmp) [times]} \quad (\text{In the case of using the internal } \times 100 \text{ (times) Amp})$$

$$\text{If } R_1 = 20\text{k}\Omega, R_2 = 20\text{k}\Omega \times g \text{ (OpAmp) [k}\Omega\text{]}$$

(fc (cut-off frequency) of HPF setting)

$$f_c \text{ (HPF1)} = 1 / (2 \times \pi \times 20\text{k}\Omega \times C_3) \text{ [Hz]}$$

$$f_c \text{ (HPF2)} = 1 / (2 \times \pi \times R_1 \times C_1) \text{ [Hz]}$$

(fc (cut-off frequency) of LPF setting)

$$f_c \text{ (LPF1)} = 1 / (2 \times \pi \times R_2 \times C_2) \text{ [Hz]}$$

(Safety Coefficient : SC)

$$SC = g / a$$

Ex) CD-ROM (to detect 0.5G shock)

SENSOR	R_1	R_2	C_1	C_2	C_3	GAIN	SC (*Note)
240p 2mV / G	8.2k Ω	820k Ω	0.47 μ F	390pF	OPEN	500	2.1
160p 1mV / G	22k Ω	220k Ω	0.22 μ F	1200pF	0.22 μ F	1000	6.3

Ex) HDD (to detect 5G shock)

SENSOR $\times 45^\circ$	R_1	R_2	C_1	C_2	C_3	GAIN	SC (*Note)
700p 0.1mV / G	22k Ω	330k Ω	0.1 μ F	68pF	0.1 μ F	1500	2.2

(*Note)

Input-impedance of this device itself is extremely high as $50M\Omega$. Input-impedance of Pin 1 is determined with the sensor-capacitance. From this reason, there is a possibility to cause an oscillation on monitoring-terminals like Pin 7 or Pin 4.

We guess CMOS-level output (0-5 Voltage swing)'s electric field of Pin 4 run into Pin 1 through the evaluation board or air. We recommend to design a surface-pattern of constant Voltage like GND on back-side of Sensor & device.

It is difficult to prevent from running into Pin 1. We try to define the SC (Safety Coefficient) parameter which figures above oscillation level.

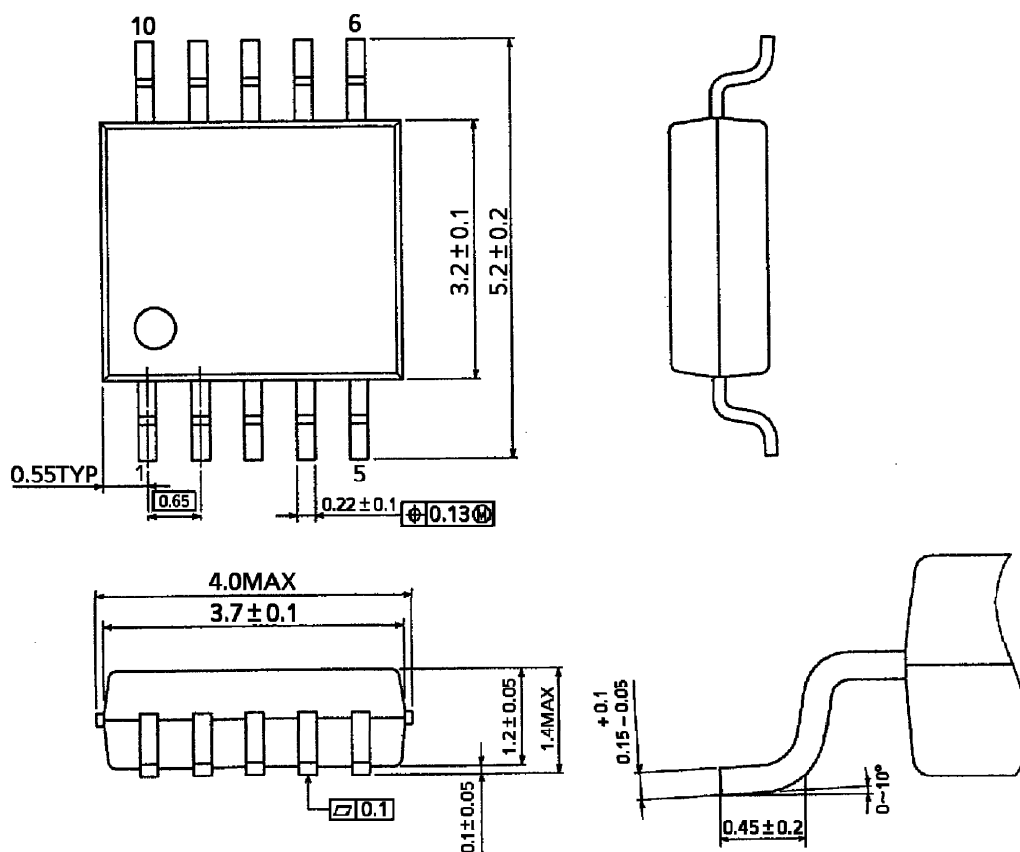
$$SC = g \text{ (total gain)} / a \text{ (Sensor capacitance)}$$

From our result of experiment, we judged a case of SC under 5 is safe for the oscillation on our evaluation board (TA8578FN2 board).

Please design G-force shock sensor system under consideration about SC parameter.

OUTLINE DRAWING
SSOP10-P-0.65A

UNIT : mm



Weight : 0.04g (Typ.)