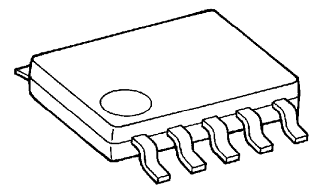
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA8578FN

SHOCK SENSOR IC (1ch VERSION)

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



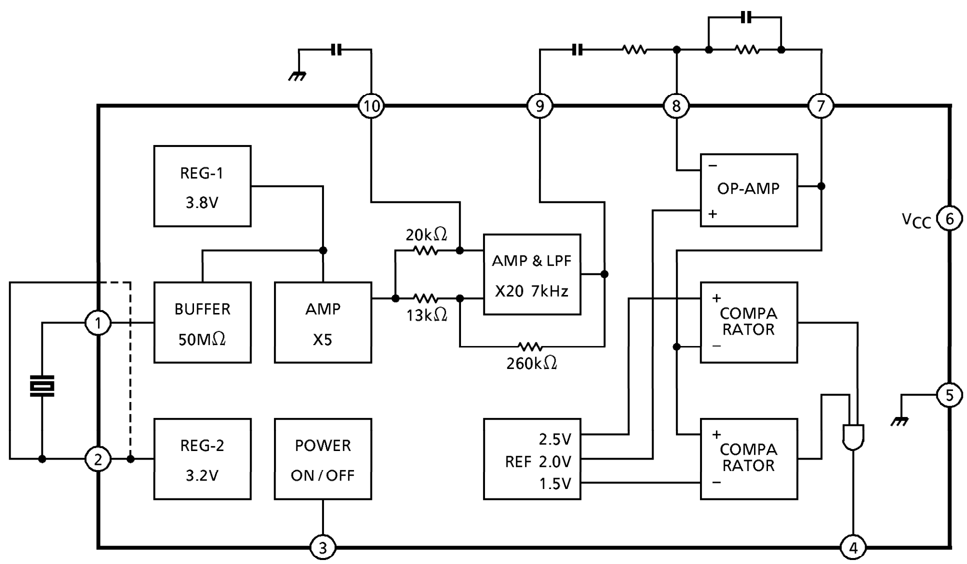
SSOP10-P-0.65A

Weight : 0.04g (Typ.)

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 = 50MΩ (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) 1.0μA (Typ.)
- Small package
  SSOP10-P-0.65A (0.65mm pitch)

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	V_{CC}	Power supply voltage
7	BO	Op-Amp output terminal
8	BI	Op-Amp input terminal
9	AO	× 100 (100 times) amplifier's output terminal
10	BYP	Connection terminal of external capacitance to set × 20 (20 times) amplifier's again. In no connection case, gain of internal Amp decreases to × 5 (5 times) Amp.

MAXIMUM RATINGS (Ta = 25°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	mV
Storage Temperature	T_{stg}	$-55 \sim 150$	°C

RECOMMEND OPERATING CONDITION

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

ELECTRICAL CHARACTERISTICS (1) (Unless Otherwise Specified, V_{CC} = 5V, Ta = 25°C)
* : Marked parameters are reference data.

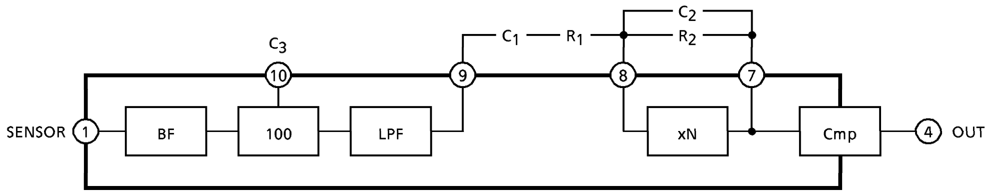
CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	—		4.2	—	5.5	V
Supply Current (In active mode)	I_{CCD}	—	Pin 3 (PS) = 5V	—	2	2.6	mA
Supply Current (In PS mode)	I_{CCS}	—	Pin 3 (PS) = 0V	—	0.1	1.0	μA
(REGULATOR)							
Output Voltage	V_{ref}	—	Pin 2 (VR)	3.1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

ELECTRICAL CHARACTERISTICS (2) (Unless Otherwise Specified, $V_{CC} = 5V$, $Ta = 25°C$)

* : Marked parameters are reference data.

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
(No.9 PIN)							
* Gain of Internal ×100 AMP	G_V1	—		39	40	41	dB
Internal LPF Cut-off Frequency	fc	—		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	Z10	—		16	20	24	kΩ
(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	Voff	—		−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	Vtrp	—	To compare with Vin (+)	±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 20kΩ.
In no connection case, Gain of internal Amp decreases to ×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 detemined as following ;

  (Gain setting)
  $500 / (n \times c) = g$ [times]
  $g / 100 = g$ (OpAmp) [times] (In the case of using the internal ×100 (times) Amp)
  If $R_1 = 20k\Omega$, $R_2 = 20k\Omega \times g$ (OpAmp) [kΩ]

  (fc (cut-off frequency) of HPF setting)
  $fc\,(HPF1) = 1 / (2 \times \pi \times 20k\Omega \times C_3)$ [Hz]
  $fc\,(HPF2) = 1 / (2 \times \pi \times R_1 \times C_1)$ [Hz]

  (fc (cut-off frequency) of LPF setting)
  $fc\,(LPF1) = 1 / (2 \times \pi \times R_2 \times C_2)$ [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	8.2kΩ	820kΩ	0.47μF	390pF	OPEN	500	2.1
160p 1mV / G	22kΩ	220kΩ	0.22μF	1200pF	0.22μF	1000	6.3

Ex) HDD (to detect 5G shock)

SENSOR × 45deg	R_1	R_2	C_1	C_2	C_3	GAIN	SC (*Note)
700p 0.1mV / G	22kΩ	330kΩ	0.1μF	68pF	0.1μF	1500	2.2

(*Note)

Input-impedance of this device itself is extermely high as 50MΩ. 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 (total gain) / a (Sensor capacitance)

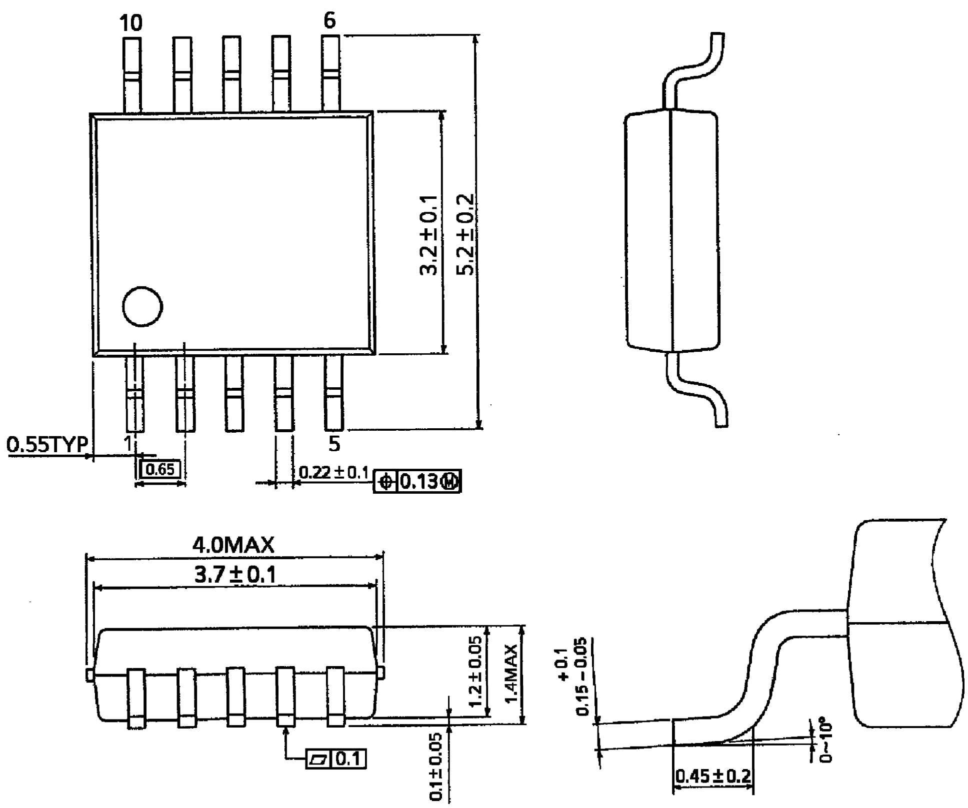
From our result of experiment, we judged a case of SC under 5 is safe for the oscillation on our evaluation board (TA8578FN2 board).

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

OUTLINE DRAWING

SSOP10-P-0.65A

UNIT : mm



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