# Piezo-sounder Driver with Multi-mode charge pump

## ■GENERAL DESCRIPTION

The NJU72501 is a switching driver with multi mode charge pump for piezo-sounder. It can drive outputs up to 18Vpp from 3V supply. For adjusting the piezoelectric sounder sound volume, the charge pump can operate in either of a 1x, 2x or 3x mode.

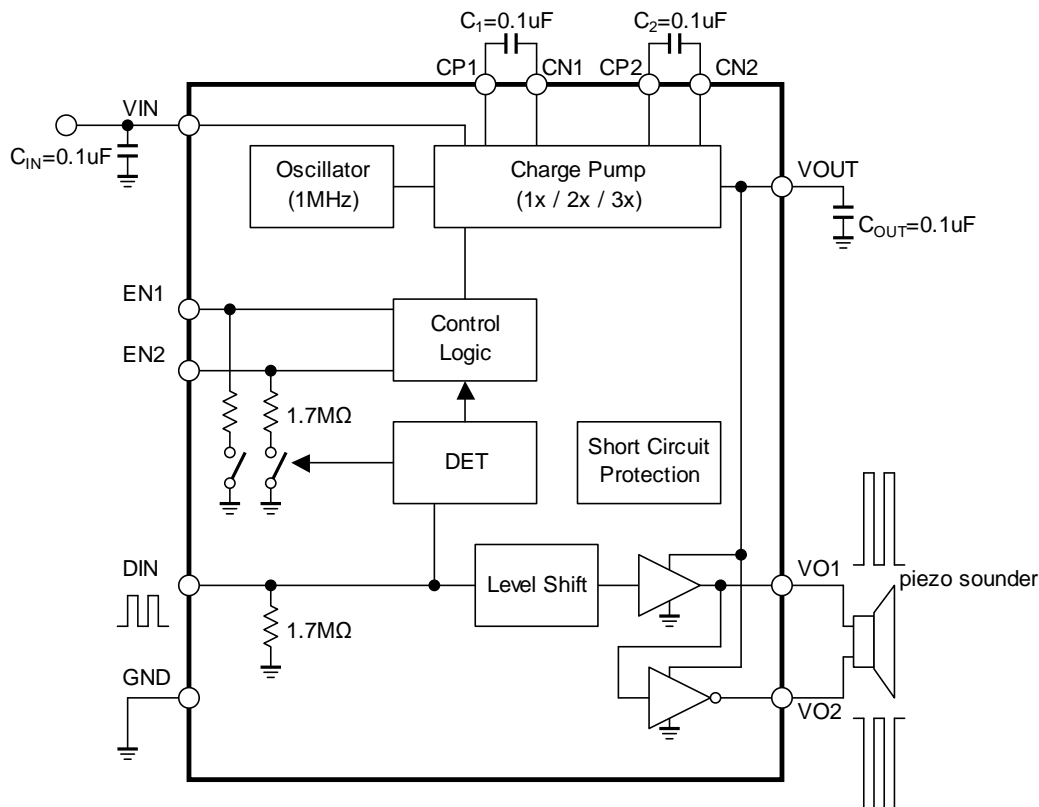Because NJU72501 has the shutdown function, it is suitable for the battery application.

## ■PACKAGE OUTLINE

**NJU72501MJE**    **NJU72501MG2**

**NJU72501V**

## ■APPLICATION

Healthcare, Wrist Watches, Alarm Clocks, Handheld GPS devices, PDAs

## ■FEATURES

● Operating Voltage : 2.3 to 5.0V(1x/ 2x Mode), 2.3 to 3.4V(3x Mode)
● Consumption current (Active) : $I_{DS}$=0.3mA typ. (VIN=3V, DIN=4kHz, $C_{PIEZO}$=15nF, 1x Mode)
  (Shutdown): $I_{DS}$=1uA max. (VIN=3V , DIN=0V)
● Multi-Mode Charge Pump (1x/2x/3x)
● Input Signal Detector & Shutdown Control
● Output Short-circuit Protection Circuit
● C-MOS Technology
● Package Outline : EQFN12-JE, EQFN16-G2, SSOP14
● Direct replacement to MAS6240

## ■BLOCK DIAGRAM

# NJU72501

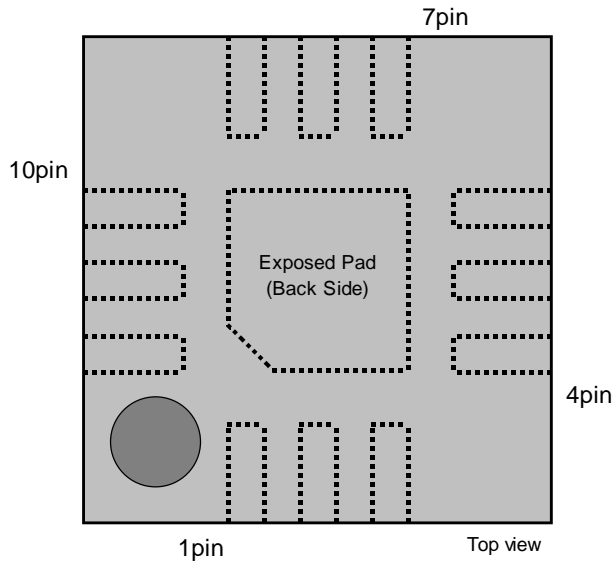■**TERMINAL CONFIGURATION (EQFN12-JE)**



7pin

10pin

Exposed Pad
(Back Side)

4pin

1pin

Top view

■**PIN DESCRIPTION**

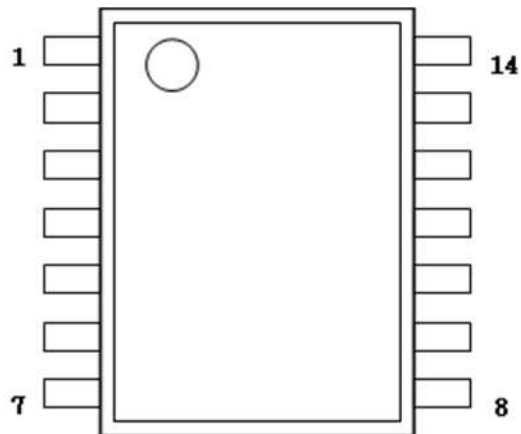| Pin No. | SYMBOL | FUNCTION |
|---------|--------|----------|
| 1 | EN1 | Step-up Mode Switch Terminal 1 |
| 2 | EN2 | Step-up Mode Switch Terminal 2 |
| 3 | DIN | Input Terminal |
| 4 | CN1 | Capacitor Connection Terminal |
| 5 | GND | GND Terminal |
| 6 | VO2 | Output Terminal 2 |
| 7 | VO1 | Output Terminal 1 |
| 8 | CN2 | Capacitor Connection Terminal |
| 9 | CP1 | Capacitor Connection Terminal |
| 10 | VOUT | Charge Pump Output Terminal |
| 11 | CP2 | Capacitor Connection Terminal |
| 12 | VIN | Power Supply Terminal |
| Exp Pad | Exposed Pad | Exposed Pad connected to GND or left floating |

■**TERMINAL CONFIGURATION (EQFN16-G2)**
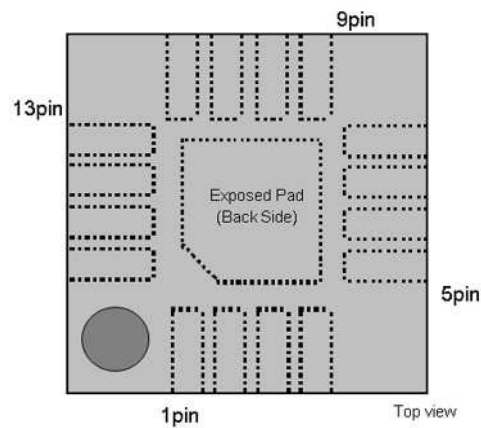


■**PIN DESCRIPTION**

| Pin No. | SYMBOL | FUNCTION |
|---------|--------|----------|
| 1 | NC | |
| 2 | EN1 | Step-up Mode Switch Terminal 1 |
| 3 | EN2 | Step-up Mode Switch Terminal 2 |
| 4 | DIN | Input Terminal |
| 5 | NC | |
| 6 | CN1 | Capacitor Connection Terminal |
| 7 | GND | GND Terminal |
| 8 | VO2 | Output Terminal 2 |
| 9 | VO1 | Output Terminal 1 |
| 10 | CN2 | Capacitor Connection Terminal |
| 11 | CP1 | Capacitor Connection Terminal |
| 12 | NC | |
| 13 | VOUT | Charge Pump Output Terminal |
| 14 | CP2 | Capacitor Connection Terminal |
| 15 | VIN | Power Supply Terminal |
| 16 | NC | |
| Exp Pad | Exposed Pad | Exposed Pad connected to GND or left floating |

# NJU72501

■**TERMINAL CONFIGURATION (SSOP14)**



| Pin No. | SYMBOL | FUNCTION |
|---------|--------|----------|
| 1 | EN2 | Step-up Mode Switch Terminal 2 |
| 2 | DIN | Input Terminal |
| 3 | CN1 | Capacitor Connection Terminal |
| 4 | GND | GND Terminal |
| 5 | VO2 | Output Terminal 2 |
| 6 | VO1 | Output Terminal 1 |
| 7 | CN2 | Capacitor Connection Terminal |
| 8 | CP1 | Capacitor Connection Terminal |
| 9 | NC | |
| 10 | VOUT | Charge Pump Output Terminal |
| 11 | CP2 | Capacitor Connection Terminal |
| 12 | VIN | Power Supply Terminal |
| 13 | NC | |
| 14 | EN1 | Step-up Mode Switch Terminal 1 |

## ■ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage | $V_{IN}$ | 5.5V 1x Mode, 2x Mode<br>4.0V 3x Mode | V |
| Input Voltage | $V_{DIN}$ | -0.3 to VIN+0.3 | V |
| Power Dissipation | $P_D$ | 480 *1) / 1300 *2) (EQFN12)<br>400 *1) / 1000 *2) (EQFN16)<br>440 *3)/550 *4) (SSOP14) | mW |
| Operating Temperature | Topr | -40 to +85 | °C |
| Storage Temperature | Tstg | -40 to +125 | °C |

(Note) *1) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting. The PAD connecting to GND in the center part on the back.

*2) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 4layers, FR-4) mounting. The PAD connecting to GND in the center part on the back. Applying a thermal via hole mounted.

*3) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting.

*4) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 4layers, FR-4) mounting.

## ■RECOMMENDED OPEARATING CONDITION (Ta=25°C)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | VIN | 1x Mode, 2x Mode | 2.3 | 3.0 | 5.0 | V |
| | | 1x Mode, 2x Mode, 3x Mode | 2.3 | 3.0 | 3.4 | |

## ■ELECTRICAL CHARACTERISTICS

(Ta=25°C, $V_{IN}$=3V, $C_1$=100nF, $C_2$=100nF, $C_{OUT}$=100nF, $C_{PIEZO}$=15nF, DIN=4kHz)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT1}$ | 1x Mode | 2.8 | - | 3 | V |
| | $V_{OUT2}$ | 2x Mode | 5.2 | - | 6 | V |
| | $V_{OUT3}$ | 3x Mode | 7.2 | - | 9 | V |
| Operating Current 1 | $I_{DD11}$ | 1x Mode $C_{PIEZO}$=no load | - | 140 | 240 | µA |
| | $I_{DD12}$ | 2x Mode $C_{PIEZO}$=no load | - | 720 | 1200 | µA |
| | $I_{DD13}$ | 3x Mode $C_{PIEZO}$=no load | - | 2500 | 4500 | µA |
| Operating Current 2 | $I_{DD21}$ | 1x Mode Single ended application | - | 0.3 | - | mA |
| | $I_{DD22}$ | 2x Mode Single ended application | - | 1.4 | - | mA |
| | $I_{DD23}$ | 3x Mode Single ended application | - | 3.9 | - | mA |
| Operating Current 3 | $I_{DD31}$ | 1x Mode Differential application | - | 0.9 | - | mA |
| | $I_{DD32}$ | 2x Mode Differential application | - | 3.6 | - | mA |
| | $I_{DD33}$ | 3x Mode Differential application | - | 7.9 | - | mA |
| Consumption Current at Shutdown | $I_{SD}$ | DIN=0V , (*1 | - | - | 1 | µA |
| Input Frequency | $F_{IN}$ | Rectangular pulse | 0.2 | 4 | 8 | kHz |
| Oscillating Frequency | $F_{OSC}$ | | 0.6 | 1 | 1.8 | MHz |

(*1: When 50msec or more maintains DIN, EN1, EN2 in 0

# NJU72501

■**ELECTRICAL CHARACTERISTICS**

(Ta=25$^{o}$C, $V_{IN}$=3V, $C_1$=100nF, $C_2$=100nF, $C_{OUT}$=100nF, $C_{PIEZO}$=15nF, DIN=4kHz)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| VOUT Start Delay Time | $T_{ON1}$ | 1x Mode<br>From DIN signal High to 90% VOUT steady state | - | 30 | 100 | μs |
| | $T_{ON2}$ | 2x Mode<br>From DIN signal High to 90% VOUT steady state | - | 90 | 200 | μs |
| | $T_{ON3}$ | 3x Mode<br>From DIN signal High to 90% VOUT steady state | - | 180 | 350 | μs |
| Shutdown Delay Time | $T_{OFF}$ | DIN=H -> L | 21 | 42 | 84 | Ms |
| Output Short-circuit Protection Limitation Current | $I_{SC}$ | | 20 | 40 | 60 | mA |

■**CONTROL PART CHARACTERISTICS**

Ta=25$^{o}$C, $V_{IN}$=3V

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Control Terminal Voltage H | $V_{IH}$ | EN1 , EN2 , DIN pins | 0.8*VIN | - | VIN | V |
| Control Terminal Voltage L | $V_{IL}$ | EN1 , EN2 , DIN pins | 0 | - | 0.2*VIN | V |
| Control Terminal Current 1 | $I_{IH1}$ | DIN=3V | - | 1.7 | 3.4 | μA |
| Control Terminal Current 2 | $I_{IH2}$ | $V_{EN1}$ , $V_{EN2}$=3V , DIN=3V | - | 1.7 | 3.4 | μA |
| Control Terminal Current 3 | $I_{IH3}$ | $V_{EN1}$ , $V_{EN2}$=3V , DIN=0V | - | - | 1 | μA |

## ■CHARGE PUMP MODE SETTING

| DIN | EN1 | EN2 | Charge Pump Mode |
|-----|-----|-----|------------------|
| 0 | - | - | Shut Down Mode |
| 1 | 0 | 0 | Shut Down Mode |
| 1 | 0 | 1 | 1x Mode |
| 1 | 1 | 0 | 2x Mode |
| 1 | 1 | 1 | 3x Mode |

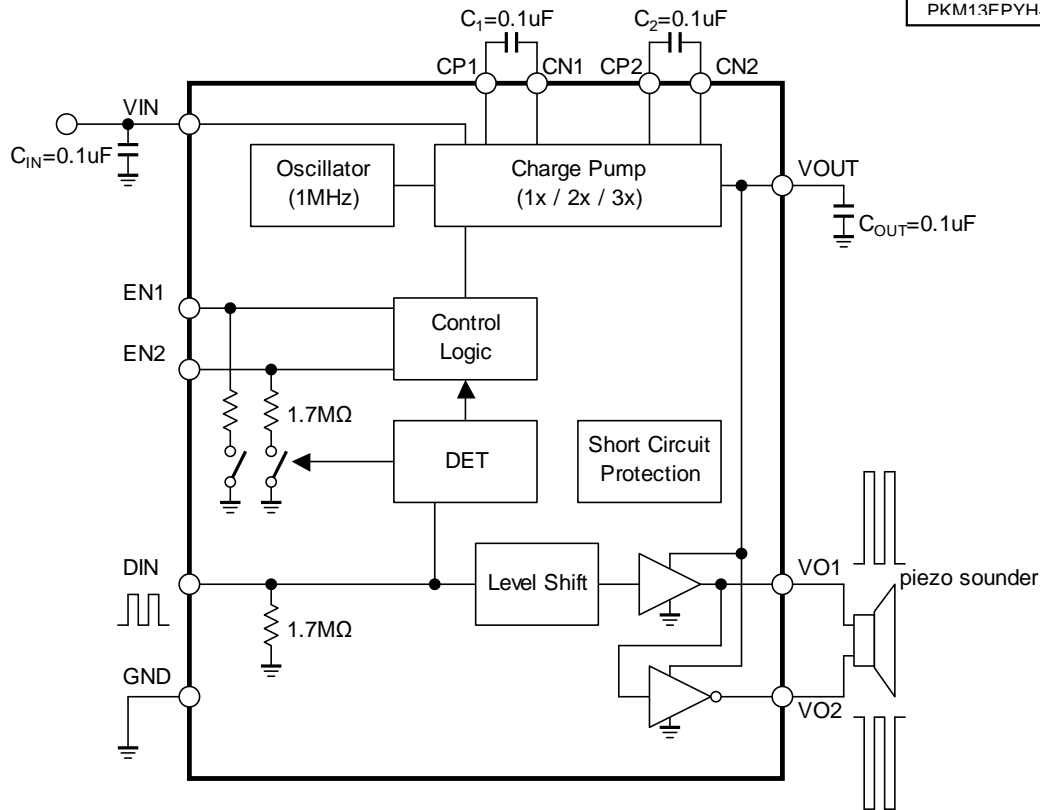## ■TIMING CHART
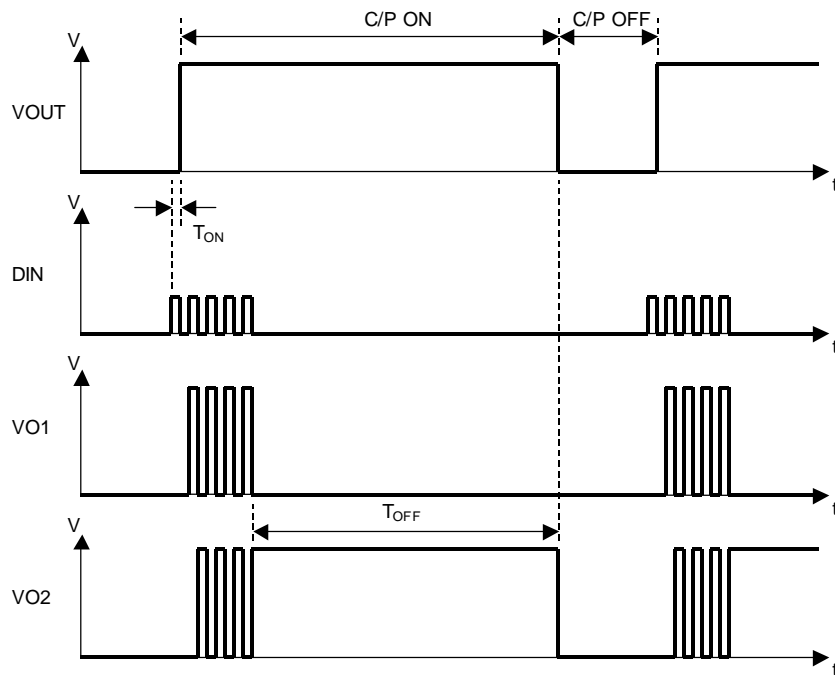
# NJU72501
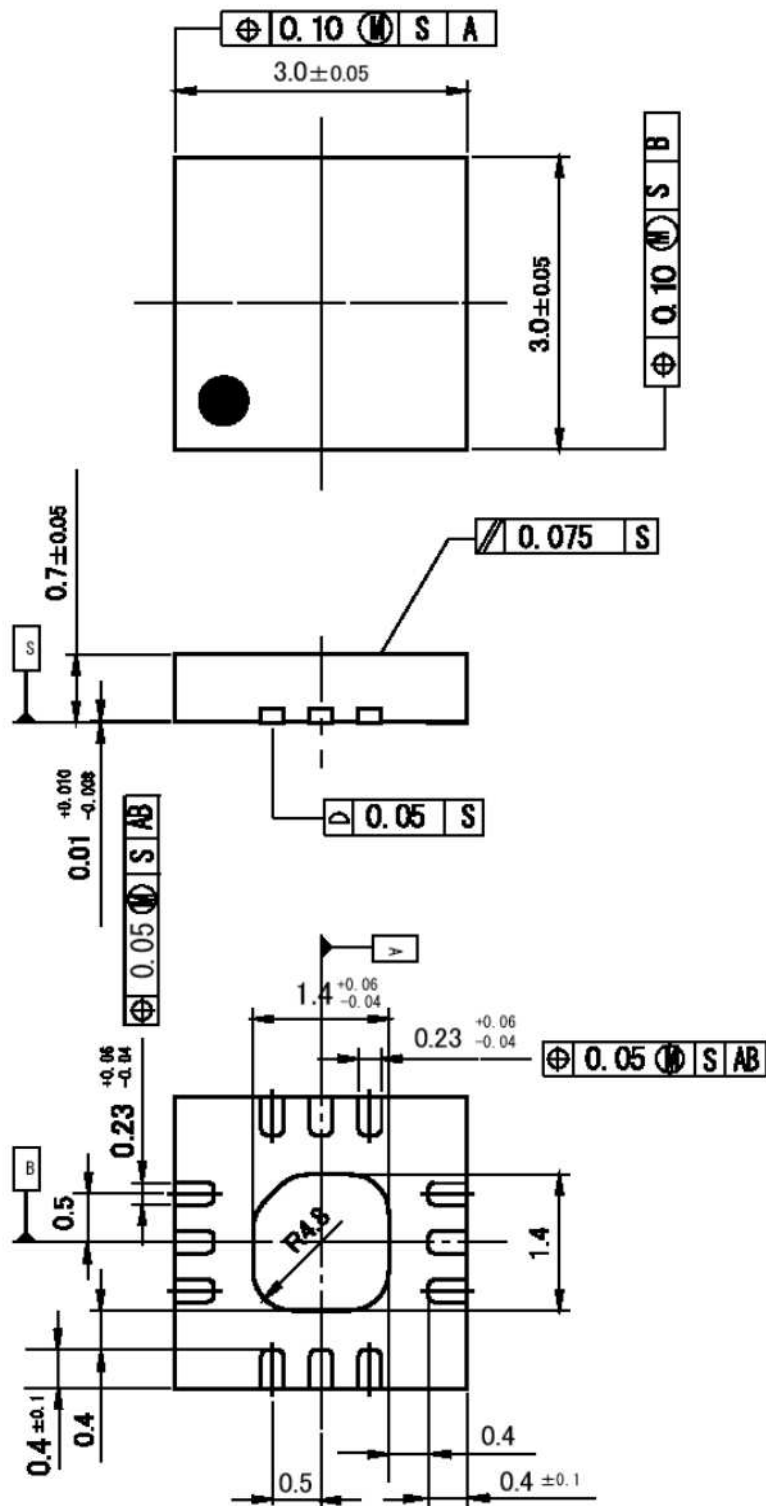
## ■APPLICATION CIRCUIT 1 (Single-end output)
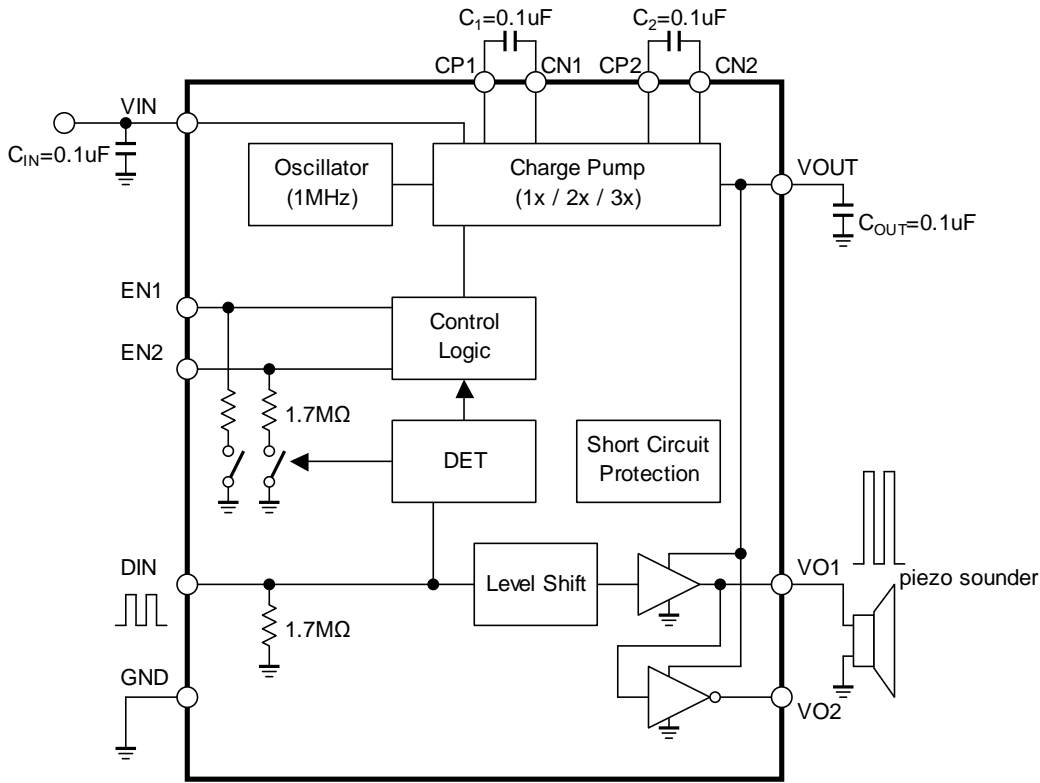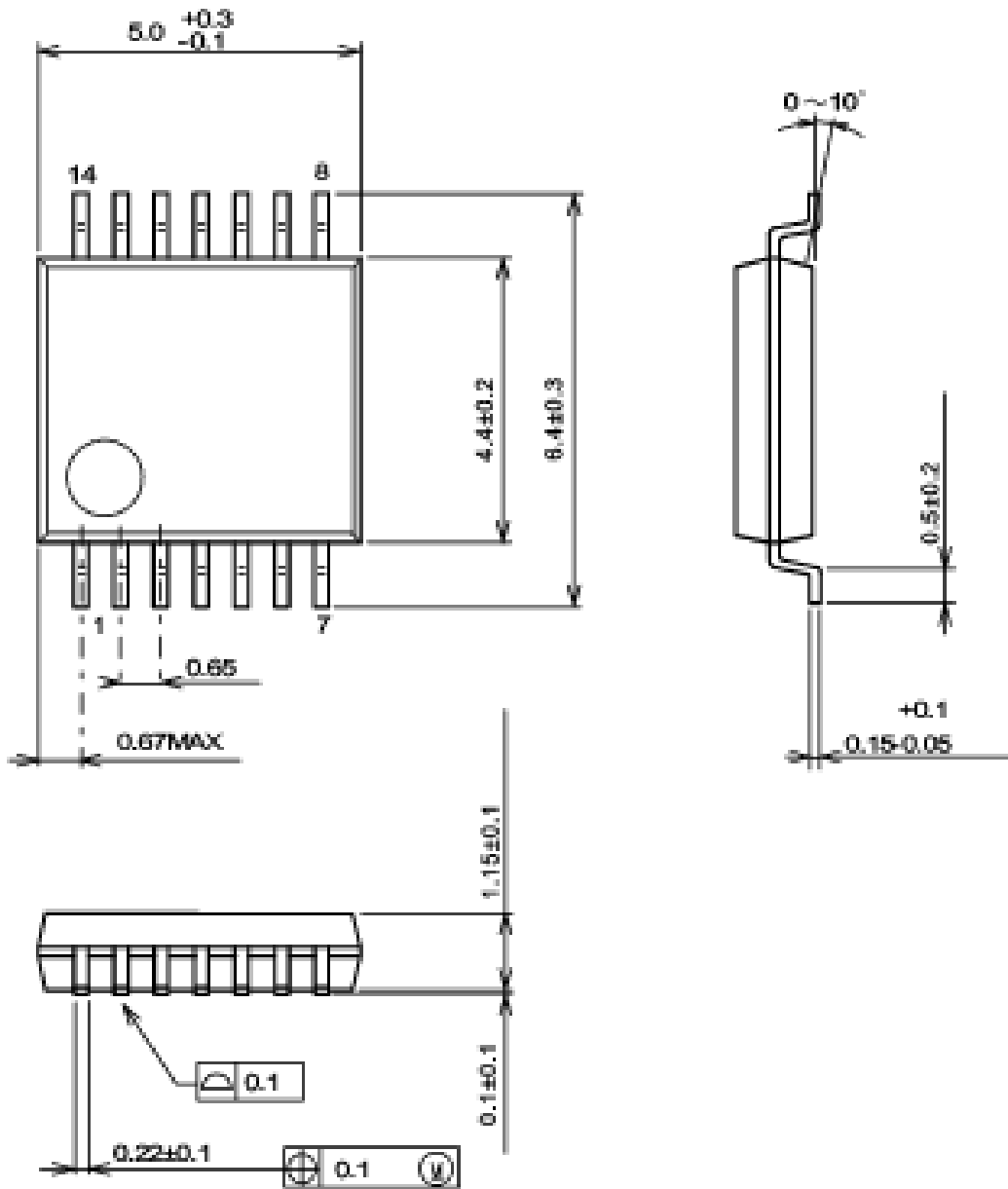


## ■APPLICATION CIRCUIT 2 (Differential output)



☐ **Recommended Parts**
Piezo-sounder/ Piezo-buzzer
PKLCS1212E2400-R1(muRata)
PKLCS1212E4001-R1(muRata)
PKM13EPYH4000-A0(muRata)

■PACKAGE INFORMATION (EQFN12-JE)

# NJU72501

■PACKAGE INFORMATION (EQFN16-G2)

■**PACKAGE INFORMATION (SSOP14)**