

Linear Vibrator Driver

CMOS LSI

LC898302AXA



WLCSP6, 0.78 x 1.18
CASE 567KP

Overview

LC898302AXA is a LRA (Linear Resonant Actuator) & ERM (Eccentric Rotating Mass) Driver IC dedicated to haptic feedback actuator and vibrator employed in mobile equipment. Due to the product superior technology, the drive frequency is automatically adjusted to the resonance frequency of the linear vibrator without the use of other external parts. As a result of this very effective drive, the vibration is as powerful as possible using very limited amount of energy compared to classical solutions

The drive and brake are fully configurable through the PWM-IF setting.

Finally, the original driving waveform allows you to reduce power consumption and it is useful to maintain battery lifetime.

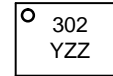
Features

- Automatic Adjustment to the Resonance Frequency for LRA
- Automatic Braking (EN Mode Only)
- Adjustable Drive Voltage Through PWM-IF Setting
- Adjustable Brake Voltage Through PWM-IF Setting
- EN/PWM-IF Driving Mode Available by Automatic Detection
- Low Standby Current
- Low Power Consumption Thanks to the Highly Effective Drive
- Low Driving Noise (EMI, Audible Band)
- Thermal Shutdown Protection
- Available to Drive a LRA or ERM
- VBAT Compliant
- This is a Pb-Free and Halogen Free Device

Applications

- Mobile Phone
- Portable Game
- Mobile Equipment with Haptics Function

MARKING DIAGRAM



302 = Specific Device Code
Y = Year
ZZ = Lot Code

ORDERING INFORMATION

| Device | Package | Shipping† |
|----------------|---|-----------------------|
| LC898302AXA-MH | WLCSP6, 0.78 x 1.18 (Pb-Free / Halogen Free) | 5000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

LC898302AXA

BLOCK DIAGRAM

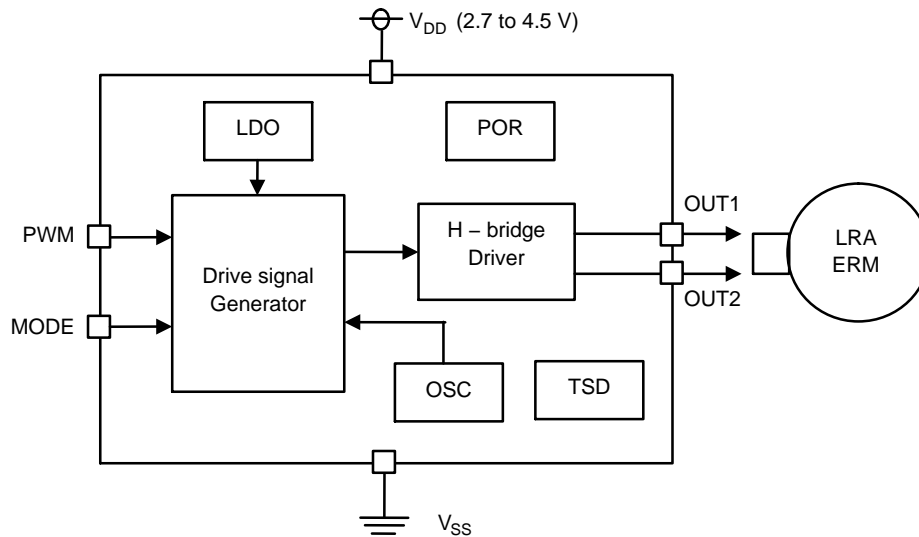


Figure 1. Block Diagram

ABSOLUTE MAXIMUM RATINGS ($V_{SS} = 0\text{ V}$)

| Parameter | Symbol | Condition | Rating | Unit |
|-----------------------------|---------------------|-----------------------------------|------------------------|------------------|
| Supply Voltage Range | $V_{DD\text{ max}}$ | | -0.3 to 6.0 | V |
| Input Voltage | V_{I1} | (Note 1) | -0.3 to $V_{DD} + 0.3$ | V |
| H-bridge Drive Current | $I_{O\text{ max}}$ | | 200 | mA |
| Allowable Power Dissipation | $P_{d\text{ max}}$ | $T_a = 85^\circ\text{C}$ (Note 2) | 116 | mW |
| Operating Temperature Range | T_a | | -30 to 85 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | | -55 to 125 | $^\circ\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. PWM, MODE pin
2. Glass epoxy (50 mm x 40 mm, $t = 0.9\text{ mm}$, FR-4)

RECOMMENDED OPERATING CONDITIONS ($T_a = -30\text{ to }85^\circ\text{C}$, $V_{CC} = 0\text{ V}$)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|----------------------|-----------|-----------|-----|-----|----------|------|
| Supply Voltage Range | V_{DD} | | 2.7 | - | 4.5 | V |
| Input Voltage Range | V_{IN1} | (Note 3) | 0 | - | V_{DD} | V |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

3. MODE, PWM pin

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ELECTRIC CHARACTERISTICS

DC CHARACTERISTICS ($V_{SS} = 0\text{ V}$, $V_{DD} = 2.7\text{ to }4.5\text{ V}$, $T_a = -30\text{ to }85^\circ\text{C}$)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit | Applicable Pin |
|--------------------------|----------|------------------------|--------------|-----|--------------|---------------|----------------|
| High Level Input Voltage | V_{IH} | CMOS | 1.40 | – | – | V | PWM |
| Low Level Input Voltage | V_{IL} | | – | – | 0.36 | V | |
| High Level Input Voltage | V_{IH} | CMOS | $0.7 V_{DD}$ | – | – | V | MODE |
| Low Level Input Voltage | V_{IL} | | – | – | $0.3 V_{DD}$ | V | |
| Input Leakage Current | I_{IL} | $V_I = V_{DD}, V_{SS}$ | –10 | – | +10 | μA | PWM, MODE |

AC INPUT CHARACTERISTICS ($V_{SS} = 0\text{ V}$, $V_{DD} = 2.7\text{ to }4.5\text{ V}$, $T_a = -30\text{ to }85^\circ\text{C}$)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---------------------|------------------|------------------------------|------|-----|------|------|
| Input PWM Frequency | f_{frq} | 1% < PWM Duty < 99% (Note 4) | 10.0 | – | 50.0 | kHz |

4. PWM carrier frequency must be set to 128 times of resonant frequency in case of LRA mode.

STANDBY CURRENT ($V_{SS} = 0\text{ V}$, $V_{DD} = 3.7\text{ V}$, $T_a = 25^\circ\text{C}$)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|------------------|-------------------|----------------|-----|-----|-----|---------------|
| Stand-by Current | P_{stb} | PWM = "0" | – | 1.0 | 3.0 | μA |
| Idle Current | P_{idle} | PWM = Duty 50% | – | 2.5 | – | mA |

ANALOG CHARACTERISTICS ($V_{SS} = 0\text{ V}$, $V_{DD} = 3.7\text{ V}$, $T_a = 25^\circ\text{C}$)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------------|------------------------------------|-----|-----|-----|-----------------|
| Output Voltage Difference OUT1 and OUT2 | V_{OUT12} | MODE = "0" Input PWM Duty = 99% | – | 2.8 | – | V _{pp} |
| | | MODE = "1" Input PWM Duty = 99% | – | 2.9 | – | V _{pp} |
| H-Bridge ON Resistance Pch | R_{onp} | $I_F = 100\text{ mA}$ | – | 2.5 | – | Ω |
| H-Bridge ON Resistance Nch | R_{onn} | $I_S = 100\text{ mA}$ | – | 1.0 | – | Ω |
| Adjustable Resonance Frequency Range | F_{mo} | vs Input value | –10 | – | +10 | % |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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PIN ASSIGNMENT

PIN LIST

| No | Name | I/O | No | Name | I/O |
|----|------|-----|----|------|-----|
| 1A | OUT1 | O | 1B | VDD | P |
| 2A | OUT2 | O | 2B | MODE | I |
| 3A | GND | P | 3B | PWM | I |

NOTE: I/O → I: input, O: output, B: bi-direction, P: power supply, NC: not connected

Pin Layout (PKG: WLCSP6, 0.4 mm pitch)

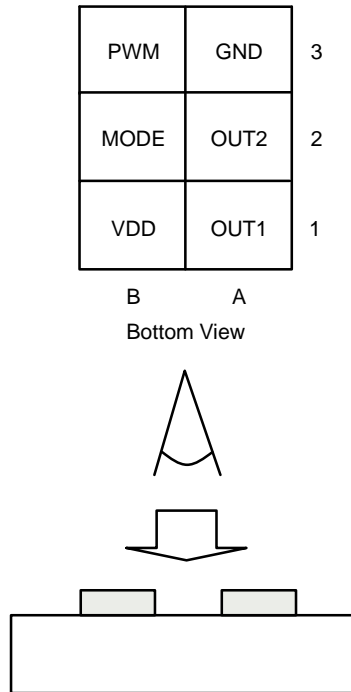


Figure 2. Pin Layout

PIN DESCRIPTION

| Signal Name | I/O | Function | Remarks |
|-------------|-----|---------------------|---------------------------------|
| OUT1 | O | Motor drive pin | H-bridge output |
| OUT2 | O | Motor drive pin | H-bridge output |
| MODE | I | Motor select pin | L: LRA, H: ERM |
| PWM | I | Driving control pin | EN control or PWM control input |
| VDD | P | Power supply pin | |
| VSS | P | GND pin | |

NOTE: I/O → I: input, O: output, B: bi-direction, P: power supply, NC: not connected

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AC CHARACTERISTICS

AC CHARACTERISTICS (V_{DD}) ($V_{SS} = 0\text{ V}$, $V_{DD} = 2.7\text{ to }4.5\text{ V}$, $T_a = -30\text{ to }85^\circ\text{C}$)

| Parameter | Symbol | Min | Typ | Max | Unit |
|----------------------|-------------|-----|-----|-----|------|
| V_{DD} Rising Time | T_{VDDUP} | – | – | 100 | kHz |

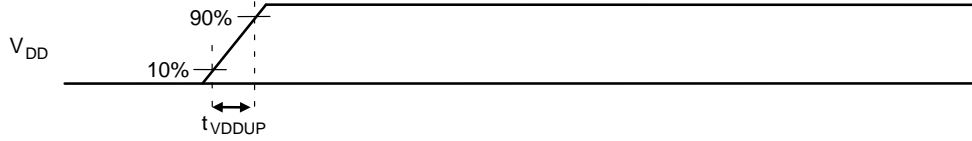


Figure 3.

AC CHARACTERISTICS (POWER ON RESET) ($V_{SS} = 0\text{ V}$, $V_{DD} = 2.7\text{ to }4.5\text{ V}$, $T_a = -30^\circ\text{C to }+85^\circ\text{C}$)

| Parameter | Symbol | Min | Typ | Max | Unit |
|---------------|------------|-----|------|-----|---------------|
| Start Up Time | t_{stup} | – | 0.55 | – | μs |

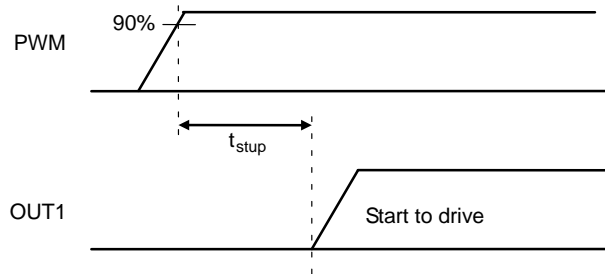


Figure 4.

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APPLICATION INFORMATION

LRA Mode

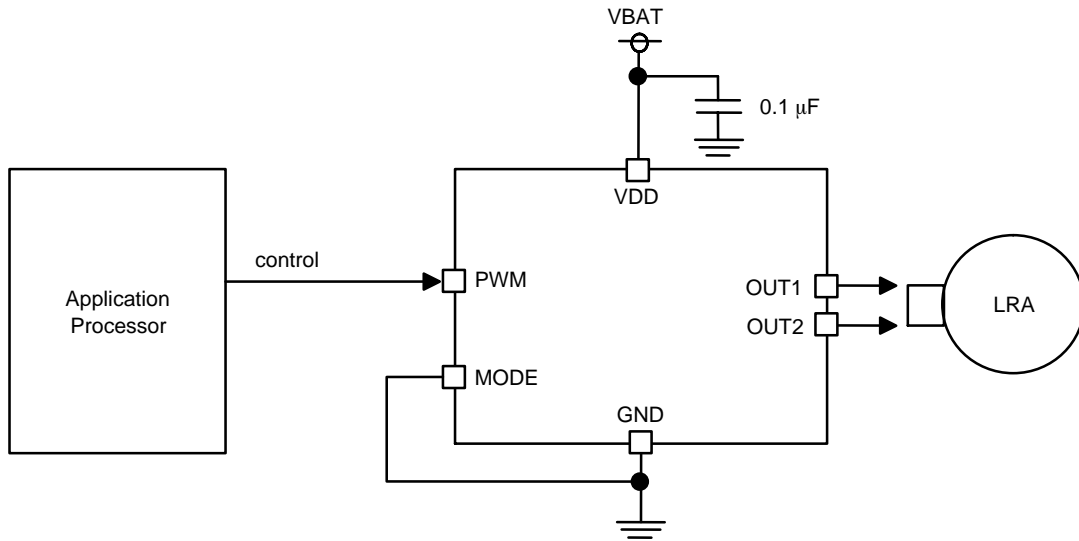
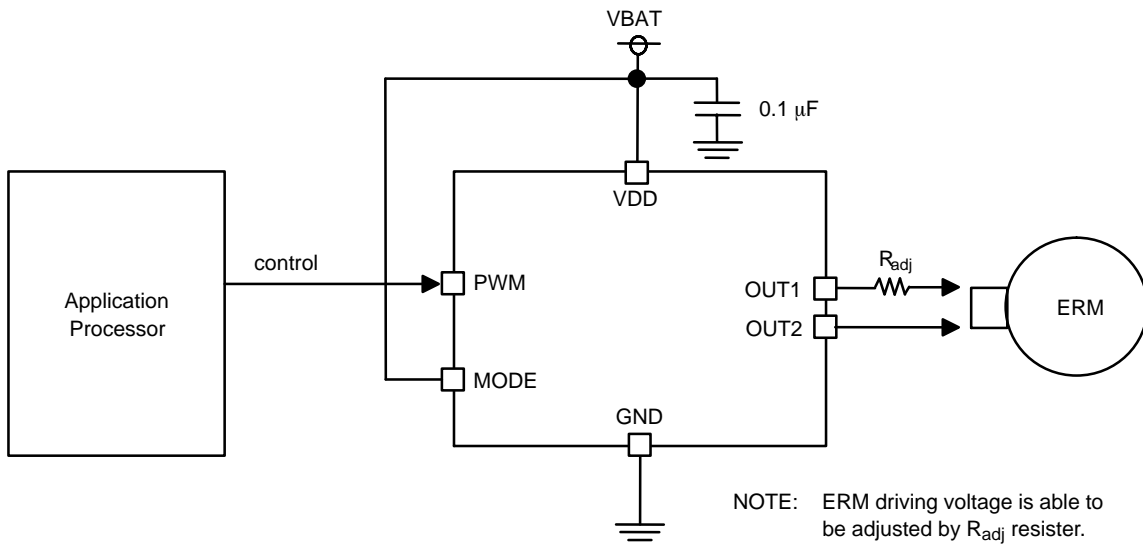


Figure 5.

ERM Mode



NOTE: ERM driving voltage is able to be adjusted by R_{adj} resistor.

Figure 6.

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

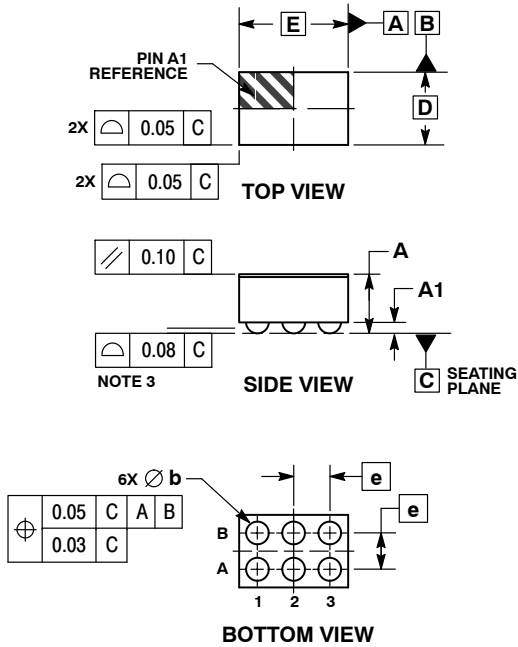
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SCALE 4:1

WLCSP6, 0.78x1.18
CASE 567KP
ISSUE O

DATE 24 SEP 2014

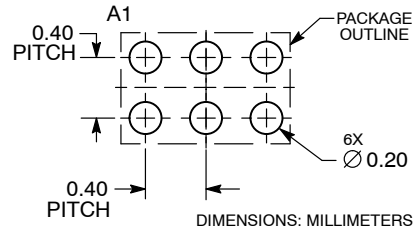


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | MIN | MAX |
| A | --- | 0.65 |
| A1 | 0.07 | 0.17 |
| b | 0.15 | 0.25 |
| D | 0.78 BSC | |
| E | 1.18 BSC | |
| e | 0.40 BSC | |

RECOMMENDED SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

| | | |
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