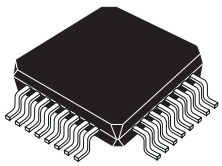
# TDA7342

## Digitally controlled audio processor

## Features

- Input multiplexer
  - Two stereo and one mono inputs
  - One quasi differential input
  - Selectable input gain for optimal adaptation to different sources
- Fully programmable loudness function
- Volume control in 0.3dB steps including gain up to 20dB
- Zero crossing mute, soft mute and direct mute
- Bass and treble control
- Four speaker attenuators
  - Four independent speakers control in 1.25dB steps for balance and fader facilities
  - Independent mute function
- All functions programmable via serial $I^2C$ bus



**LQFP32**

## Description

The audioprocessor TDA7342 is an upgrade of the TDA731X audioprocessor family.

Due to a highly linear signal processing, using CMOS-switching techniques instead of standard bipolar multipliers, very low distortion and very low noise are obtained. Several new features like softmute, and zero-crossing mute are implemented. The soft Mute function can be activated in two ways:

1. Via serial bus (Mute byte, bit D0)
2. Directly on pin 21 through an I/O line of the microcontroller

Very low DC stepping is obtained by use of a BICMOS technology.

## Order codes

| Part number | Package | Packing |
|---|---|---|
| TDA7342 | LQFP32 | Tray |
| TDA7342TR | LQFP32 | Tape and reel |

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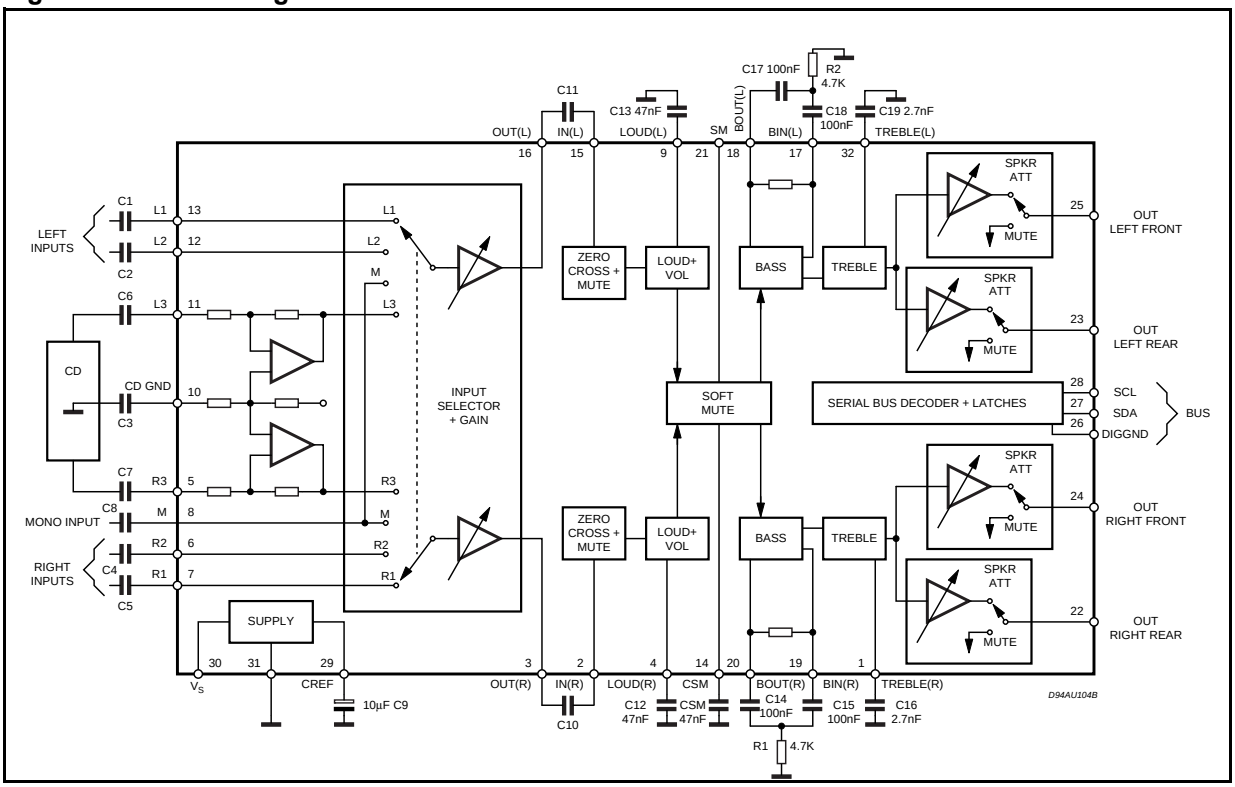
# 1 Block diagram and pin description

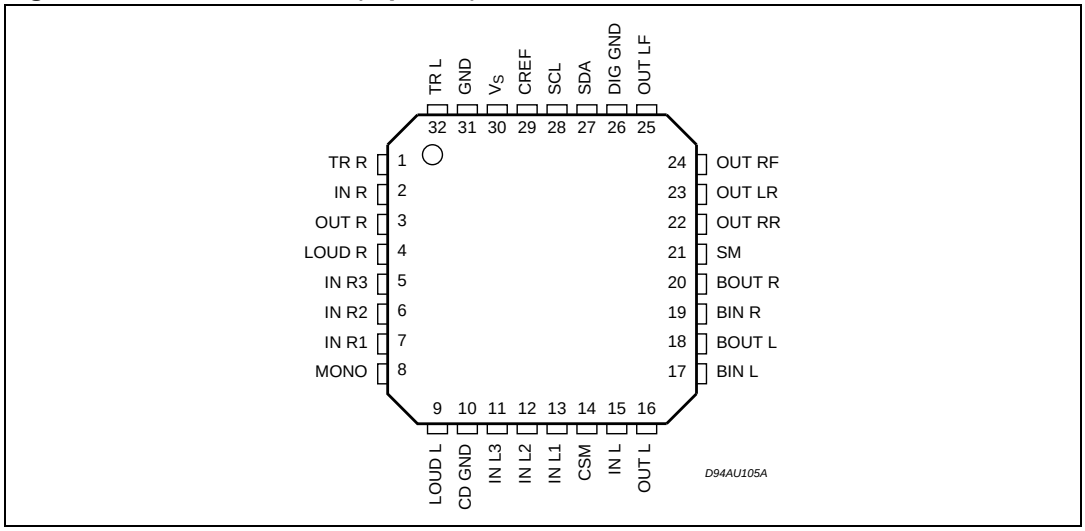
## 1.1 Block diagram

**Figure 1. Block diagram**




## 1.2 Pin description

**Figure 2. Pin connection (top view)**



# 2 Electrical specifications

## 2.1 Absolute maximum ratings

**Table 1. Absolute Maximum Ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_S$ | Operating supply voltage | 10.5 | V |
| $T_{amb}$ | Operating ambient temperature | -40 to 85 | °C |
| $T_{stg}$ | Storage temperature range | -55 to 150 | °C |

## 2.2 Quick reference data

**Table 2. Quick reference data**

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $V_S$ | Supply voltage | 6 | 9 | 10.2 | V |
| $V_{CL}$ | Max. input signal handling | 2.1 | 2.6 | | Vrms |
| THD | Total harmonic distortion V = 1Vrms f = 1KHz | | 0.01 | 0.08 | % |
| S/N | Signal to noise ratio | | 106 | | dB |
| $S_C$ | Channel separation | | 100 | | dB |
| | Volume control 0.3dB step | -59.7 | | 20 | dB |
| | Treble control 2dB step | -14 | | +14 | dB |
| | Bass control 2dB step | -10 | | +18 | dB |
| | Fader and balance control 1.25dB step | -38.75 | | 0 | dB |
| | Input gain 3.75dB step | 0 | | 11.25 | dB |
| | Mute attenuation | | 100 | | dB |

## 2.3 Thermal data

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{th\ j\text{-}amb}$ | Thermal resistance junction to pins | 150 | °C/W |

## 2.4 Electrical characteristics

**Table 4. Electrical characteristics**
($V_S$ = 9V; $R_L$ = 10KΩ; $R_g$ = 50Ω; $T_{amb}$ = 25°C; all gains = 0dB; f = 1KHz. Refer to the test circuit, unless otherwise specified.)

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Input selector** | | | | | | |
| $R_I$ | Input resistance | | 70 | 100 | 130 | KΩ |
| $V_{CL}$ | Clipping level | d ≤ 0.3% | 2.1 | 2.6 | | $V_{RMS}$ |
| $S_I$ | Input separation | | 80 | 100 | | dB |
| $R_L$ | Output load resistance | | 2 | | | KΩ |
| $G_{I\ MIN}$ | Minimum input gain | | -0.75 | 0 | 0.75 | dB |
| $G_{I\ MAX}$ | Maximum input gain | | 10.25 | 11.25 | 12.25 | dB |
| $G_{step}$ | Step resolution | | 2.75 | 3.75 | 4.75 | dB |
| $e_N$ | Input noise | 20Hz to 20 KHz unweighted | | 2.3 | | μV |
| $V_{DC}$ | DC steps | Adiacent Gain Steps | | 1.5 | 10 | mV |
| | | $G_{IIN}$to $G_{IMAX}$ | | 3 | | mV |
| **Differential input ( IN 3)** | | | | | | |
| $R_I$ | Input resistance | Input selector BIT D6 = 0 (0dB) | 10 | 15 | 20 | KΩ |
| | | Input selector BIT D6 = 1(-6dB) | 14 | 20 | 30 | KΩ |
| CMRR | Common mode rejection ratio | $V_{CM}$ = 1$V_{RMS}$; f =1KHz | 48 | 75 | | dB |
| | | f = 10KHz | 45 | 70 | | dB |
| d | Distortion | $V_I$= 1$V_{RMS}$ | | 0.01 | 0.08 | % |
| $e_{IN}$ | Input noise | 20Hz to 20KHz; Flat; D6 = 0 | | 5 | | μV |
| $G_{DIFF}$ | Differential gain | D6 = 0 | -1 | 0 | 1 | dB |
| | | D6 = 1 | -7 | -6 | -5 | dB |
| **Volume control** | | | | | | |
| $R_I$ | Input resistance | | 35 | 50 | | KΩ |
| $G_{MAX}$ | Maximum gain | | 18.75 | 20 | 21.25 | dB |
| $A_{MAX}$ | Maximum attenuation | | 57.7 | 59.7 | 62.7 | dB |
| $A_{STEPC}$ | Step resolution coarse atten. | | 0.5 | 1.25 | 2.0 | dB |
| $A_{STEPF}$ | Step resolution fine attenuation | | 0.11 | 0.31 | 0.51 | dB |
| $E_A$ | Attenuation set error | G = 20 to -20dB | -1.25 | 0 | 1.25 | dB |
| | | G = -20 to -58dB | -3 | | 2 | dB |
| $E_t$ | Tracking error | | | | 2 | dB |
| $V_{DC}$ | DC steps | Adiacent Attenuation Steps | -3 | 0 | 3 | mV |
| | | From 0dB to $A_{MAX}$ | | 0.5 | 5 | mV |

**Table 4. Electrical characteristics (continued)**
($V_S$ = 9V; $R_L$ = 10KΩ; $R_g$ = 50Ω; $T_{amb}$ = 25°C; all gains = 0dB; f = 1KHz. Refer to the test circuit, unless otherwise specified.)

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Loudness control** | | | | | | |
| $R_I$ | Internal resistor | Loud = On | 35 | 50 | 65 | KΩ |
| $A_{MAX}$ | Maximum attenuation | | 17.5 | 18.75 | 20.0 | dB |
| $A_{step}$ | Step resolution | | 0.5 | 1.25 | 2.0 | dB |
| **Zero crossing mute** | | | | | | |
| $V_{TH}$ | Zero crossing threshold (1) | WIN = 11 | | 20 | | mV |
| | | WIN = 10 | | 40 | | mV |
| | | WIN = 01 | | 80 | | mV |
| | | WIN = 00 | | 160 | | mV |
| $A_{MUTE}$ | Mute attenuation | | 80 | 100 | | dB |
| $V_{DC}$ | DC step | 0dB to Mute | | 0 | 3 | mV |
| **Soft mute** | | | | | | |
| $A_{MUTE}$ | Mute attenuation | | 45 | 60 | | dB |
| $T_{DON}$ | On delay time | $C_{CSM}$ = 22nF; 0 to -20dB; I = $I_{MAX}$ | 0.7 | 1 | 1.7 | ms |
| | | $C_{CSM}$ = 22nF; 0 to -20dB; I = $I_{MIN}$ | 20 | 35 | 55 | ms |
| $I_{DOFF}$ | Off current | $V_{CSM}$= 0V; I = $I_{MAX}$ | 25 | 50 | 75 | µA |
| | | $V_{CSM}$= 0V; I = $I_{MIN}$ | | 1 | | µA |
| $V_{THSM}$ | Soft mute threshold (pin 14) | | 1.5 | 2.5 | 3.5 | V |
| $R_{INT}$ | Pull-up resistor (pin 21) | (2) | 35 | 50 | 65 | kΩ |
| $V_{SMH}$ | (pin 21) level high | | 3.5 | | | V |
| $V_{SML}$ | (pin 21) level low | Soft mute active | | | 1 | V |
| **Bass control** | | | | | | |
| $B_{BOOST}$ | Max bass boost | | 15 | 18 | 20 | dB |
| $B_{CUT}$ | Max bass cut | | -8.5 | -10 | -11.5 | dB |
| $A_{step}$ | Step resolution | | 1 | 2 | 3 | dB |
| $R_g$ | Internal feedback resistance | | 45 | 65 | 85 | KΩ |
| **Treble control** | | | | | | |
| $C_{RANGE}$ | Control range | | ±13 | ±14 | ±15 | dB |
| $A_{step}$ | Step resolution | | 1 | 2 | 3 | dB |
| **Speaker attenuators** | | | | | | |
| $C_{RANGE}$ | Control range | | 35 | 37.5 | 40 | dB |
| $A_{step}$ | Step resolution | | 0.5 | 1.25 | 2.00 | dB |

**Table 4. Electrical characteristics (continued)**
($V_S$ = 9V; $R_L$ = 10KΩ; $R_g$ = 50Ω; $T_{amb}$ = 25°C; all gains = 0dB; f = 1KHz. Refer to the test circuit, unless otherwise specified.)

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $A_{MUTE}$ | Output mute attenuation | Data word = XXX11111 | 80 | 100 | | dB |
| $E_A$ | Attenuation set error | | | | 1.25 | dB |
| $V_{DC}$ | DC steps | Adjacent attenuation steps | | 0 | 3 | mV |
| **Audio output** | | | | | | |
| $V_{clip}$ | Clipping level | d = 0.3% | 2.1 | 2.6 | | Vrms |
| $R_L$ | Output load resistance | | 2 | | | KΩ |
| $R_O$ | Output impedance | | | 30 | 100 | Ω |
| $V_{DC}$ | DC voltage Level | | 3.5 | 3.8 | 4.1 | V |
| **General** | | | | | | |
| $V_{CC}$ | Supply voltage | | 6 | 9 | 10.2 | V |
| $I_{CC}$ | Supply current | | 5 | 10 | 15 | mA |
| PSRR | Power supply rejection ratio | f = 1KHz | 60 | 80 | | dB |
| | | B = 20 to 20kHz "A" weighted | | 65 | | dB |
| $e_{NO}$ | Output noise | Output Muted (B = 20 to 20kHz flat) | | 2.5 | | μV |
| | | All Gains 0dB (B = 20 to 20kHz flat) | | 5 | 15 | μV |
| $E_t$ | Total tracking error | $A_V$= 0 to -20dB | | 0 | 1 | dB |
| | | $A_V$= -20 to -60dB | | 0 | 2 | dB |
| S/N | Signal to noise ratio | All Gains = 0dB; $V_O$= 1Vrms | | 106 | | dB |
| $S_C$ | Channel separation | | 80 | 100 | | dB |
| d | Distortion | $V_{IN}$ =1V | | 0.01 | 0.08 | % |
| **Bus inputs** | | | | | | |
| $V_{IL}$ | Input low voltage | | | | 1 | V |
| $V_{IN}$ | Input high voltage | | 3 | | | V |
| $I_{IN}$ | Input current | $V_{IN}$ = 0.4V | -5 | | 5 | μA |
| $V_O$ | Output voltage SDA acknowledge | $I_O$= 1.6mA | | 0.4 | 0.8 | V |

1. WIN represents the MUTE programming bit pair D6, D5 for the zero crossing window threshold.
2. Internal pull-up resistor to Vs/2; LOW = softmute active.

# 3 $I^2C$ bus interface

Data transmission from microprocessor to the TDA7342 and viceversa takes place thru the 2 wires $I^2C$ BUS interface, consisting of the two lines SDA and SCL (pull-up resistors to positive supply voltage must be externally connected).

## 3.1 Data Validity

As shown in *Figure 3*, the data on the SDA line must be stable during the high period of the clock. The HIGH and LOW state of the data line can only change when the clock signal on the SCL line is LOW.

## 3.2 Start and Stop Conditions

As shown in *Figure 5* a start condition is a HIGH to LOW transition of the SDA line while SCL is HIGH. The stop condition is a LOW to HIGH transition of the SDA line while SCL is HIGH.

A STOP conditions must be sent before each START condition.

## 3.3 Byte Format

Every byte transferred to the SDA line must contain 8 bits. Each byte must be followed by an acknowledge bit. The MSB is transferred first.

## 3.4 Acknowledge

The master (µP) puts a resistive HIGH level on the SDA line during the acknowledge clock pulse (see *Figure 5*). The peripheral (audioprocessor) that acknowledges has to pull-down (LOW) the SDA line during the acknowledge clock pulse, so that the SDA line is stable LOW during this clock pulse.

The audioprocessor which has been addressed has to generate an acknowledge after the reception of each byte, otherwise the SDA line remains at the HIGH level during the ninth clock pulse time. In this case the master transmitter can generate the STOP information in order to abort the transfer.

## 3.5 Transmission without Acknowledge

Avoiding to detect the acknowledge of the audioprocessor, the µP can use a simplier transmission: simply it waits one clock without checking the slave acknowledging, and sends the new data. This approach of course is less protected from misworking and decreases the noise immunity.

**Figure 3. Data Validity on the I²C BUS**

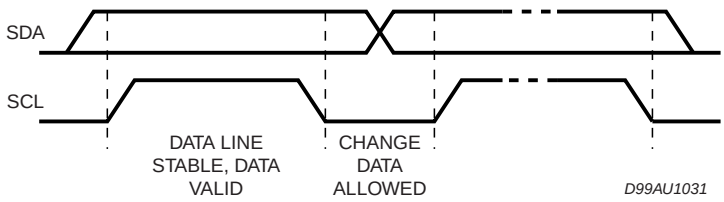



**Figure 4. Timing Diagram of I²C BUS**

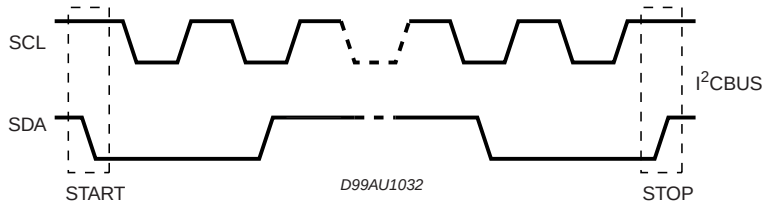
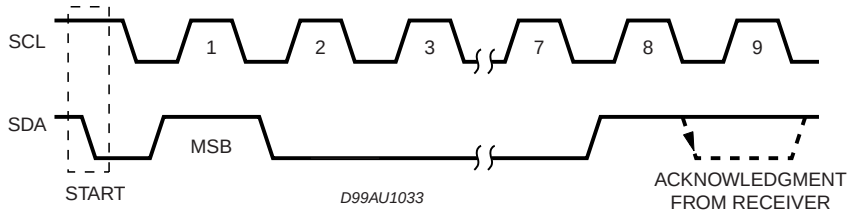



**Figure 5. Acknowledge on the I²C BUS**




**Patent note:** **Purchase of I²C Components of STMicrolectronics, conveys a license under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specifications as defined by Philips.**

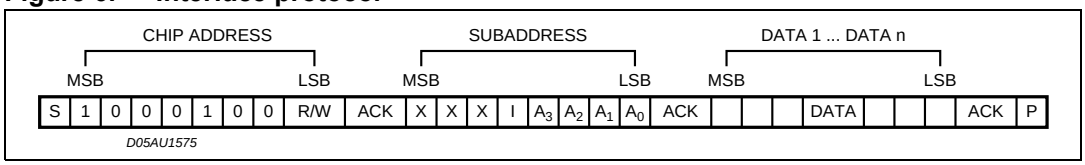
# 4 Software specification

## 4.1 Interface Protocol

The interface protocol comprises:

- A start condition (s)
- A chip address byte, (the LSB bit determines read/write transmission)
- A subaddress byte.
- A sequence of data (N-bytes + acknowledge)
- A stop condition (P)

**Figure 6. Interface protocol**




ACK = Acknowledge

S = Start

P = Stop

I = Auto Increment

X = Not used

A = $I^2C$ address value selectable according to ADDR pin status
ADDR = Open/Gnd A = O
ADDR = $V_{CC}$ A = I

MAX CLOCK SPEED 500kbits/s

## 4.2 Auto increment

If bit I in the subaddress byte is set to "1", the autoincrement of the subaddress is enabled

**Table 5. Subaddress (receive mode)**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| X | X | X | I | A3 | A2 | A1 | A0 | |
| | | | | 0 | 0 | 0 | 0 | Input Selector |
| | | | | 0 | 0 | 0 | 1 | Loudness |
| | | | | 0 | 0 | 1 | 0 | Volume |
| | | | | 0 | 0 | 1 | 1 | Bass, Treble |
| | | | | 0 | 1 | 0 | 0 | Speaker Attenuator LF |
| | | | | 0 | 1 | 0 | 1 | Speaker Attenuator LR |
| | | | | 0 | 1 | 1 | 0 | Speaker Attenuator RF |
| | | | | 0 | 1 | 1 | 1 | Speaker Attenuator RR |
| | | | | 1 | 0 | 0 | 0 | Mute |

## 4.3 Transmitted data

**Table 6. Send mode**

| MSB | | | | | | | LSB |
|---|---|---|---|---|---|---|---|
| X | X | X | X | X | SM | ZM | X |

ZM = Zero crossing muted (HIGH active)

SM = Soft mute activated (HIGH active)

X = Not used

The transmitted data is automatically updated after each ACK.

Transmission can be repeated without new chip address.

## 4.4 Data byte specification

X = not relevant; set to "1" during testing

**Table 7. Input selector**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| 0 | | 1 | | | 0 | 0 | 0 | not used |
| 0 | | 1 | | | 0 | 0 | 1 | IN 2 |
| 0 | | 1 | | | 0 | 1 | 0 | IN 1 |
| 0 | | 1 | | | 0 | 1 | 1 | AM mono |
| 0 | | 1 | | | 1 | 0 | 0 | not used |
| 0 | | 1 | | | 1 | 0 | 1 | not used |
| 0 | | 1 | | | 1 | 1 | 0 | not allowed |
| 0 | | 1 | | | 1 | 1 | 1 | not allowed |
| 0 | | 1 | 0 | 0 | | | | 11.25dB gain |
| 0 | | 1 | 0 | 1 | | | | 7.5dB gain |
| 0 | | 1 | 1 | 0 | | | | 3.75dB gain |
| 0 | | 1 | 1 | 1 | | | | 0dB gain |
| | 0 | | | | | | | 0dB differential input gain (IN3) |
| | 1 | | | | | | | -6dB differential input gain (IN3) |

For example to select the IN 2 input with a gain of 7.5dB the Data Byte is: X X 1 0 1 0 0 1

**Table 8. Loudness**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| X | X | X | 0 | 0 | 0 | 0 | 0 | 0dB |
| X | X | X | 0 | 0 | 0 | 0 | 1 | -1.25dB |
| X | X | X | 0 | 0 | 0 | 1 | 0 | -2.5dB |
| X | X | X | 0 | 0 | 0 | 1 | 1 | -3.75dB |
| X | X | X | 0 | 0 | 1 | 0 | 0 | -5dB |
| X | X | X | 0 | 0 | 1 | 0 | 1 | -6.25dB |
| X | X | X | 0 | 0 | 1 | 1 | 0 | -7.5dB |
| X | X | X | 0 | 0 | 1 | 1 | 1 | -8.75dB |
| X | X | X | 0 | 1 | 0 | 0 | 0 | -10dB |
| X | X | X | 0 | 1 | 0 | 0 | 1 | -11.25dB |
| X | X | X | 0 | 1 | 0 | 1 | 0 | -12.5dB |
| X | X | X | 0 | 1 | 0 | 1 | 1 | -13.75dB |
| X | X | X | 0 | 1 | 1 | 0 | 0 | -15dB |
| X | X | X | 0 | 1 | 1 | 0 | 1 | -16.25dB |
| X | X | X | 0 | 1 | 1 | 1 | 0 | -17.5dB |
| X | X | X | 0 | 1 | 1 | 1 | 1 | -18.75dB |
| X | X | X | 1 | D3 | D2 | D1 | D0 | Loudness OFF (1) |

1. If the loudness is switched OFF, the loudness stage is acting like a volume attenuator with flat frequency response. D0 to D3 determine the attenuation level.

For example to select -17.5dB attenuation, loudness OFF, the Data Byte is: X X X1 1 1 1 0

**Table 9. Mute**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| | | | | | | | 1 | Soft Mute On |
| | | | | | | 0 | 1 | Soft Mute with fast slope (I = $I_{MAX}$) |
| | | | | | | 1 | 1 | Soft Mute with slow slope (I = $I_{MIN}$) |
| | | | | 1 | | | | Direct Mute |
| | | | 0 | | 1 | | | Zero Crossing Mute On |
| | | | 0 | | 0 | | | Zero Crossing Mute Off (delayed until next zerocrossing) |
| | | | 1 | | | | | Zero Crossing Mute and Pause Detector Reset |
| | 0 | 0 | | | | | | 160mV ZC Window Threshold (WIN = 00) |

**Table 9. Mute (continued)**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| | 0 | 1 | | | | | | 80mV ZC Window Threshold (WIN = 01) |
| | 1 | 0 | | | | | | 40mV ZC Window Threshold (WIN = 10) |
| | 1 | 1 | | | | | | 20mV ZC Window Threshold (WIN = 11) |
| 0 | | | | | | | | Nonsymmetrical Bass Cut (1) |
| 1 | | | | | | | | Symmetrical Bass Cut |

1. Bass cut for very low frequencies; should not be used at +16 and +18dB bass boost (DC gain)

An additional direct mute function is included in the Speaker Attenuators.

**Table 10. Speaker attenuators (LF, LR, RF, RR)**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| | | | | | | | | **1.25dB step** |
| X | X | X | | | 0 | 0 | 0 | 0dB |
| X | X | X | | | 0 | 0 | 1 | -1.25dB |
| X | X | X | | | 0 | 1 | 0 | -2.5dB |
| X | X | X | | | 0 | 1 | 1 | -3.75dB |
| X | X | X | | | 1 | 0 | 0 | -5dB |
| X | X | X | | | 1 | 0 | 1 | -6.25dB |
| X | X | X | | | 1 | 1 | 0 | -7.5dB |
| X | X | X | | | 1 | 1 | 1 | -8.75dB |
| | | | | | | | | **10dB step** |
| X | X | X | 0 | 0 | | | | 0dB |
| X | X | X | 0 | 1 | | | | -10dB |
| X | X | X | 1 | 0 | | | | -20dB |
| X | X | X | 1 | 1 | | | | -30dB |
| X | X | X | 1 | 1 | 1 | 1 | 1 | Speaker Mute |

For example an attenuation of 25dB on a selected output is given by: X X X1 0 1 0 0

**Table 11. Bass/Treble**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| | | | | | | | | **Treble step** |
| | | | | 0 | 0 | 0 | 0 | -14dB |
| | | | | 0 | 0 | 0 | 1 | -12dB |

Table 11. Bass/Treble (continued)

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| | | | | 0 | 0 | 1 | 0 | -10dB |
| | | | | 0 | 0 | 1 | 1 | -8dB |
| | | | | 0 | 1 | 0 | 0 | -6dB |
| | | | | 0 | 1 | 0 | 1 | -4dB |
| | | | | 0 | 1 | 1 | 0 | -2dB |
| | | | | 0 | 1 | 1 | 1 | 0dB |
| | | | | 1 | 1 | 1 | 1 | 0dB |
| | | | | 1 | 1 | 1 | 0 | 2dB |
| | | | | 1 | 1 | 0 | 1 | 4dB |
| | | | | 1 | 1 | 0 | 0 | 6dB |
| | | | | 1 | 0 | 1 | 1 | 8dB |
| | | | | 1 | 0 | 1 | 0 | 10dB |
| | | | | 1 | 0 | 0 | 1 | 12dB |
| | | | | 1 | 0 | 0 | 0 | 14dB |
| | | | | | | | | **Bass steps** |
| 0 | 0 | 1 | 0 | | | | | -10dB |
| 0 | 0 | 1 | 1 | | | | | -8dB |
| 0 | 1 | 0 | 0 | | | | | -6dB |
| 0 | 1 | 0 | 1 | | | | | -4dB |
| 0 | 1 | 1 | 0 | | | | | -2dB |
| 0 | 1 | 1 | 1 | | | | | -0dB |
| 1 | 1 | 1 | 1 | | | | | -0dB |
| 1 | 1 | 1 | 0 | | | | | 2dB |
| 1 | 1 | 0 | 1 | | | | | 4dB |
| 1 | 1 | 0 | 0 | | | | | 6dB |
| 1 | 0 | 1 | 1 | | | | | 8dB |
| 1 | 0 | 1 | 0 | | | | | 10dB |
| 1 | 0 | 0 | 1 | | | | | 12dB |
| 1 | 0 | 0 | 0 | | | | | 14dB |
| 0 | 0 | 0 | 1 | | | | | 146B |
| 0 | 0 | 0 | 0 | | | | | 18dB |

For example 12dB Treble and -8dB Bass give the following DATA BYTE: 0 0 1 1 1 0 0 1

**Table 12. Volume**

| MSB | | | | | | | LSB | Function |
|---|---|---|---|---|---|---|---|---|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| | | | | | | | | **0.31dB Fine Attenuation Steps** |
| | | | | | | 0 | 0 | 0dB |
| | | | | | | 0 | 1 | -0.31dB |
| | | | | | | 1 | 0 | -0.62dB |
| | | | | | | 1 | 1 | -0.94dB |
| | | | | | | | | **1.25dB Coarse Attenuation Steps** |
| | | | 0 | 0 | 0 | | | 0dB |
| | | | 0 | 0 | 1 | | | -1.25dB |
| | | | 0 | 1 | 0 | | | -2.5dB |
| | | | 0 | 1 | 1 | | | -3.75dB |
| | | | 1 | 0 | 0 | | | -5dB |
| | | | 1 | 0 | 1 | | | -6.25dB |
| | | | 1 | 1 | 0 | | | -7.5dB |
| | | | 1 | 1 | 1 | | | -8.75dB |
| | | | | | | | | **10dB Gain / Attenuation Steps** |
| 0 | 0 | 0 | | | | | | 20dB |
| 0 | 0 | 1 | | | | | | 10dB |
| 0 | 1 | 0 | | | | | | 0dB |
| 0 | 1 | 1 | | | | | | -10dB |
| 1 | 0 | 0 | | | | | | -20dB |
| 1 | 0 | 1 | | | | | | -30dB |
| 1 | 1 | 0 | | | | | | -40dB |
| 1 | 1 | 1 | | | | | | -50dB |

For example to select -47.81dB Volume the Data Byte is: 1 1 0 1 1 0 0 1

Power on RESET: All Bytes Set to 1 1 1 1 1 1 1 0

# 5 Package information

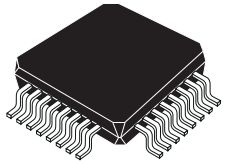
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

**Figure 7. LQFP32 Mechanical Data & Package Dimensions**

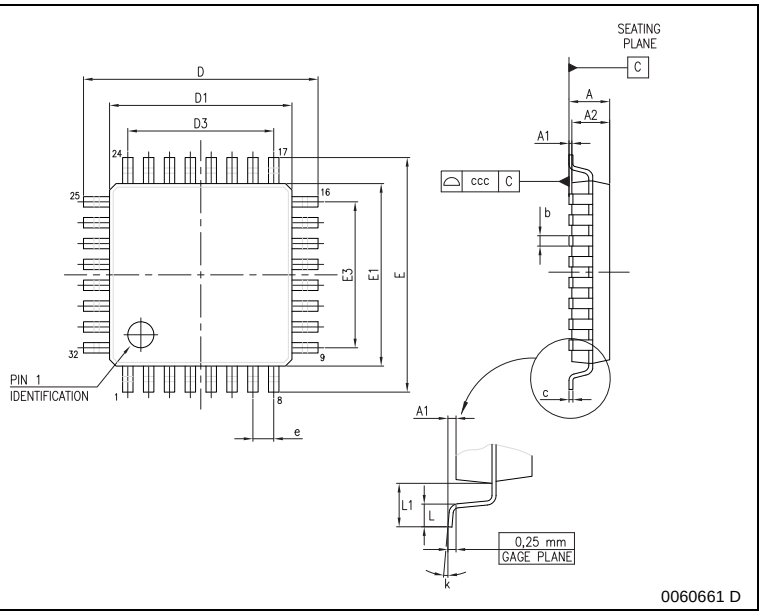
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.600 | | | 0.0630 |
| A1 | 0.050 | | 0.150 | 0.0020 | | 0.0059 |
| A2 | 1.350 | 1.400 | 1.450 | 0.0531 | 0.0551 | 0.0571 |
| b | 0.300 | 0.370 | 0.450 | 0.0118 | 0.0146 | 0.0177 |
| c | 0.090 | | 0.200 | 0.0035 | | 0.0079 |
| D | 8.800 | 9.000 | 9.200 | 0.3465 | 0.3543 | 0.3622 |
| D1 | 6.800 | 7.000 | 7.200 | 0.2677 | 0.2756 | 0.2835 |
| D3 | | 5.600 | | | 0.2205 | |
| E | 8.800 | 9.000 | 9.200 | 0.3465 | 0.3543 | 0.3622 |
| E1 | 6.800 | 7.000 | 7.200 | 0.2677 | 0.2756 | 0.2835 |
| E3 | | 5.600 | | | 0.2205 | |
| e | | 0.800 | | | 0.0315 | |
| L | 0.450 | 0.600 | 0.750 | 0.0177 | 0.0236 | 0.0295 |
| L1 | | 1.000 | | | 0.0394 | |
| K | | 3.500 | 7.000 | | 0.1378 | 0.2756 |
| ccc | | | 0.100 | | | 0.0039 |

**OUTLINE AND MECHANICAL DATA**

**Weight:** 0.20gr



**LQFP32 (7 x 7 x 1.40mm)**



# 6 Revision history

Table 13. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 24-Jan-2006 | 1 | Initial release. |
| 20-Nov-2006 | 2 | Layout changes, text modifications, updated package informations. |
| 24-Sep-2013 | 3 | Updated Disclaimer. |

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