

**AUDIO MATRIX WITH SRS EFFECTS**

**SRS**  *The Device incorporates the SRS (Sound Retrieval System) under licence from SRS Labs, Inc. everything else is only stereo™*

- 1 STEREO INPUT
- INPUT ATTENUATION CONTROL IN 0.5dB STEP
  - MUTE FUNCTION
- MONO MODE (SRS 3D MONO)
- STEREO MODE (SRS 3D STEREO)
- SPACE AND CENTER ATTENUATORS ARE AVAILABLE
- ALL FUNCTION ARE PROGRAMMABLE VIA SERIAL BUS (I<sup>2</sup>C BUS)

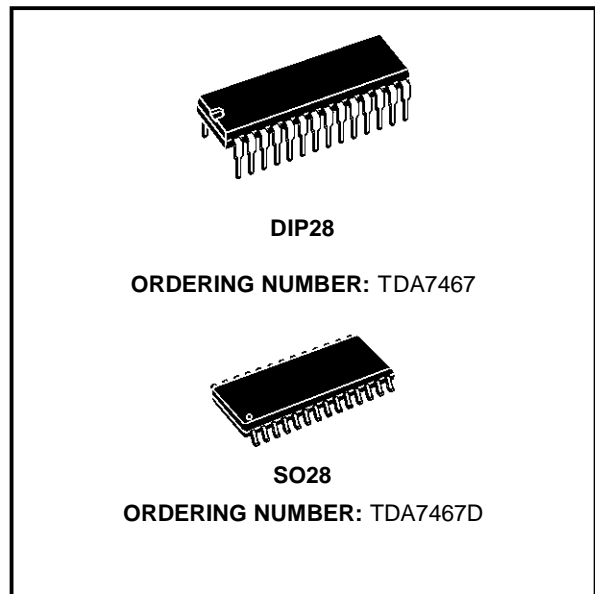
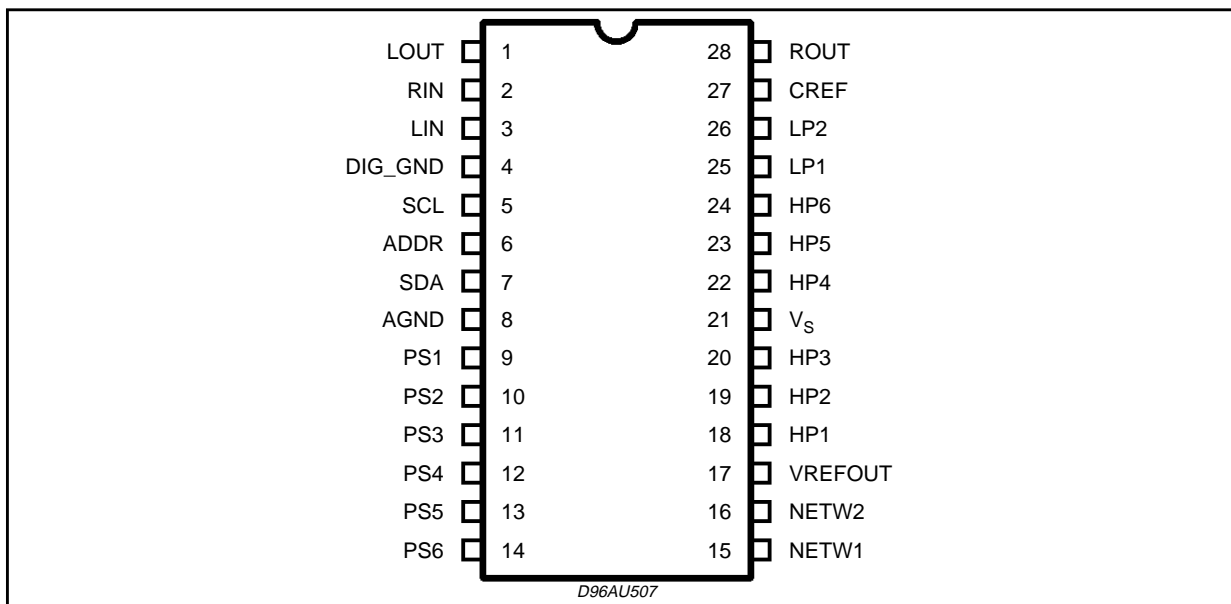
**DESCRIPTION**

The TDA7467 is a SRS (Sound Retrieval System) audio matrix. It reproduces SRS sound processing stereo and mono sources both.

The SRS sound is guaranteed by external components and it is not affected by internal process spreads.

The AC signal setting is obtained by resistor networks and switches combined with operational amplifiers according to the SRS labs specifica-

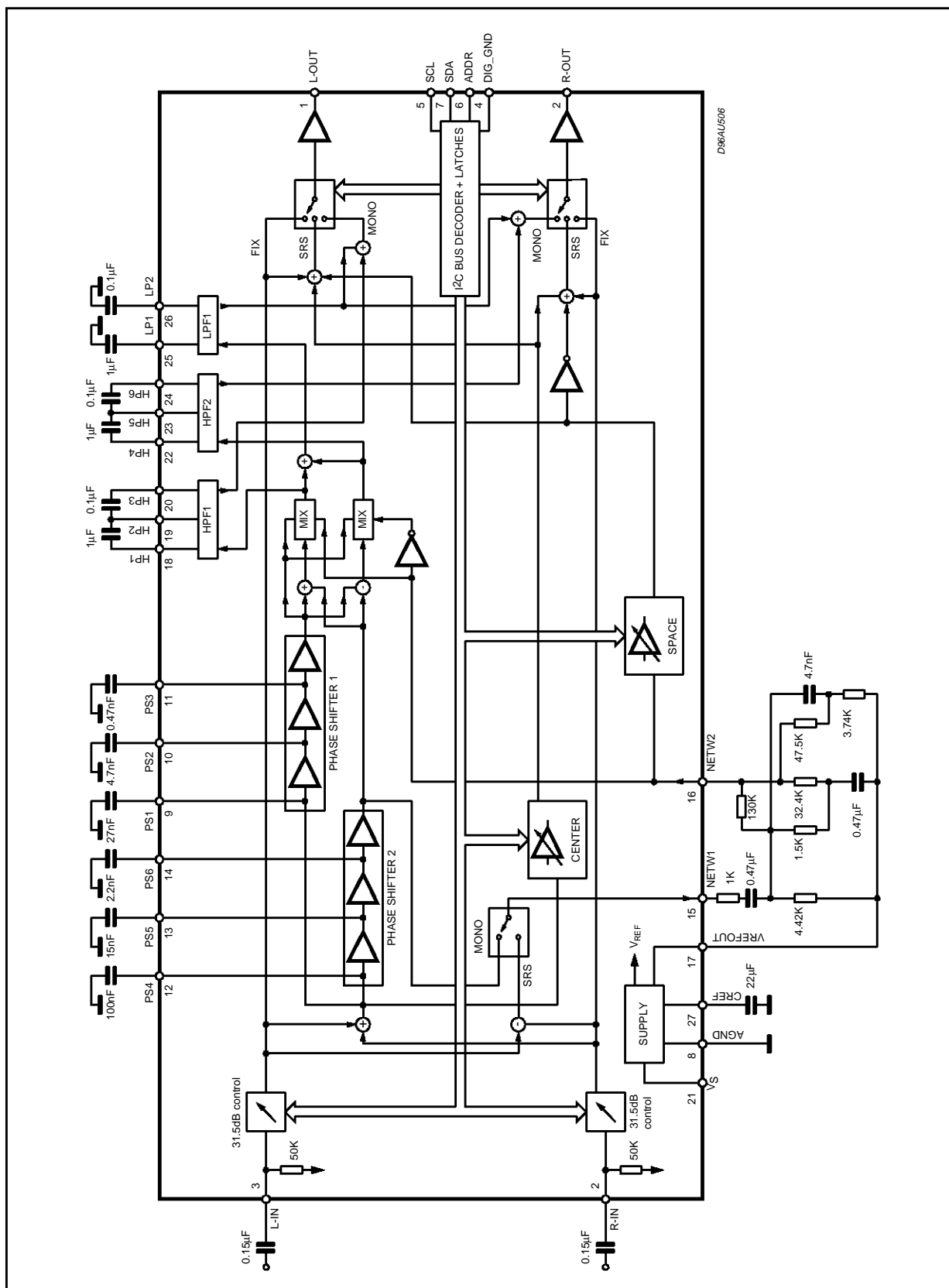
**PIN CONNECTION (Top view)**



tion.

Control of all the functions is accomplished by serial bus. Thanks to the used BIPOLAR/CMOS/DMOS technology, Low Distortion, Low Noise and DC stepping are obtained.

BLOCK DIAGRAM



## THERMAL DATA

| Symbol           | Description                      | Value   | Unit |
|------------------|----------------------------------|---------|------|
| $R_{th\ j-pins}$ | Thermal Resistance Junction-pins | Max. 85 | °C/W |

## ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                     | Value       | Unit |
|-----------|-------------------------------|-------------|------|
| $V_S$     | Operating Supply Voltage      | 11          | V    |
| $T_{amb}$ | Operating Ambient Temperature | -10 to 85   | °C   |
| $T_{stg}$ | Storage Temperature Range     | -55 to +150 | °C   |

## QUICK REFERENCE DATA

| Symbol   | Parameter   | Min.  | Typ. | Max. | Unit |
|----------|---|-------|------|------|------|
| $V_S$    | Supply Voltage  | 7     | 9    | 10.2 | V    |
| $V_{CL}$ | Max. input signal handling                              | 2     |      |      | Vrms |
| THD      | Total Harmonic Distortion $V = 1V_{rms}$ $f = 1KHz$     |       | 0.01 | 0.1  | %    |
| S/N      | Signal to Noise Ratio $V_{out} = 1V_{rms}$ (mode = OFF) |       | 106  |      | dB   |
| $S_C$    | Channel Separation $f = 1KHz$                           |       | 90   |      | dB   |
|          | Input Control (0.5dB)                                   | -31.5 |      | 0    | dB   |
|          | SRS Center Control (1dB step)                           | -31   |      | 0    | dB   |
|          | SRS Space Control (1dB step)                            | -31   |      | 0    | dB   |
|          | Mute Attenuation  |       | 100  |      | dB   |

**ELECTRICAL CHARACTERISTICS** (refer to the test circuit  $T_{amb} = 25^{\circ}C$ ,  $V_S = 9V$ ,  $R_L = 10K\Omega$ ,  $V_{in} = 1V_{rms}$ ;  $R_G = 600\Omega$ , all controls flat ( $G = 0dB$ ), Effect Ctrl = -6dB, MODE = OFF;  $f = 1KHz$  unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|----------------|------|------|------|------|
|--------|-----------|----------------|------|------|------|------|

## SUPPLY

|       |                  |                           |    |    |      |    |
|-------|------------------|---------------------------|----|----|------|----|
| $V_S$ | Supply Voltage   |                           | 7  | 9  | 10.2 | V  |
| $I_S$ | Supply Current   |                           |    | 25 |      | mA |
| SVR   | Ripple Rejection | LCH / RCH out, Mode = OFF | 60 | 80 |      | dB |

## INPUT STAGE

|               |                  |                    |      |      |      |            |
|---------------|------------------|--------------------|------|------|------|------------|
| $R_{IN}$      | Input Resistance |                    | 37.5 | 50   | 62.5 | K $\Omega$ |
| $V_{CL}$      | Clipping Level   | THD = 0.3%         | 2    | 2.5  |      | Vrms       |
| $A_{V_{MIN}}$ | Min. Attenuation |                    | -1   | 0    | 1    | dB         |
| $A_{V_{MAX}}$ | Max. Attenuation |                    | 31   | 31.5 | 32   | dB         |
| $A_{STEP}$    | Step Resolution  |                    | -1   | 0.5  | 1    | dB         |
| $V_{DC}$      | DC Steps         | Adjacent att. step | -3   | 0    | 3    | mV         |

## SRS EFFECT CONTROL

|              |                              |  |     |   |   |    |
|--------------|------------------------------|--|-----|---|---|----|
| $C_{range1}$ | Center/Space Control Range   |  | -31 |   | 0 | dB |
| $S_{step1}$  | Center/Space Step Resolution |  |     | 1 |   | dB |

**ELECTRICAL CHARACTERISTICS (continued)**

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|----------------|------|------|------|------|
|--------|-----------|----------------|------|------|------|------|

**AUDIO OUTPUTS**

|              |                                   |                                       |   |        |     |                          |
|--------------|-----------------------------------|---------------------------------------|---|--------|-----|--------------------------|
| $N_{o(Off)}$ | Output Noise (OFF)                | Output muted, Flat BW (20Hz to 20KHz) |   | 4<br>5 |     | $\mu$ Vrms<br>$\mu$ Vrms |
| $N_{o(srs)}$ | Output noise (srs) Surround Sound | BW (20Hz to 20KHz)                    |   | 50     |     | $\mu$ Vrms               |
| d            | Distortion                        | $A_V = 0$ ; $V_{in} = 1V_{rms}$       |   | 0.01   | 0.1 | %                        |
| $S_C$        | Channel Separation                |                                       |   | 90     |     | dB                       |
| $V_{ocl}$    | Clipping Level                    | $d = 0.3\%$                           | 2 | 2.5    |     | Vrms                     |
| $R_{out}$    | Output Resistance                 |                                       |   | 30     |     | $\Omega$                 |
| $V_{out}$    | DC Voltage Level                  |                                       |   | 3.8    |     | V                        |

**BUS INPUTS**

|          |                                |               |    |  |     |         |
|----------|--------------------------------|---------------|----|--|-----|---------|
| $V_{il}$ | Input Low Voltage              |               |    |  | 1   | V       |
| $V_{ih}$ | Input High Voltage             |               | 3  |  |     | V       |
| $I_{in}$ | Input Current                  |               | -5 |  | 5   | $\mu$ A |
| $V_o$    | Output Voltage SDA Acknowledge | $I_o = 1.6mA$ |    |  | 0.4 | V       |

**SRS SURROUND SOUND MATRIX**

|                    |                         |  |     |       |   |    |
|--------------------|-------------------------|--|-----|-------|---|----|
| CENTER             | SRS Control Range       |  | -31 |       | 0 | dB |
| Step <sub>c</sub>  | Center Step Resolution  |  |     | 1     |   | dB |
| SPACE              | SRS Space Control Range |  |     | -31   | 0 | dB |
| Step <sub>s</sub>  | Space Step Resolution   |  |     | 1     |   | dB |
| P <sub>ERSP1</sub> | Perspective 1           | Input Signal of 125Hz<br>SPACE = 0dB, CENTER = MUTE<br>$R_{in} = GND$ ; $L_{in} \rightarrow R_{OUT}$                         |     | 12    |   | dB |
| P <sub>ERSP2</sub> | Perspective 2           | Input Signal of 2.15KHz<br>SPACE = 0dB, CENTER = MUTE<br>$R_{in} = GND$ ; $L_{in} \rightarrow R_{OUT}$                       |     | 0     |   | dB |
| L+R                | L+ R SRS Curve          | SPACE = MUTE, CENTER = 0dB<br>$R_{in} = GND$ ; $L_{in} \rightarrow R_{OUT}$  |     | -8.5  |   | dB |
| L, R               | L, R SRS Curve          | SPACE = MUTE, CENTER = 0dB<br>$R_{in} = GND$ ; $L_{in} \rightarrow L_{OUT}$<br>$L_{in} = GND$ ; $R_{in} \rightarrow R_{OUT}$ |     | -13.4 |   | dB |

## I<sup>2</sup>C BUS INTERFACE

Data transmission from microprocessor to the TDA7467 and viceversa takes place through the 2 wires I<sup>2</sup>C BUS interface, consisting of the two lines SDA and SCL (pull-up resistors to positive supply voltage must be connected).

### Data Validity

As shown in fig. 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.

### Start and Stop Conditions

As shown in fig.4 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.

### Byte Format

Every byte transferred on the SDA line must contain 8 bits. Each byte must be followed by an ac-

knowledge bit. The MSB is transferred first.

### Acknowledge

The master ( $\mu$ P) puts a resistive HIGH level on the SDA line during the acknowledge clock pulse (see fig. 5). The peripheral (audioprocessor) that acknowledges has to pull-down (LOW) the SDA line 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.

### Transmission without Acknowledge

Avoiding to detect the acknowledge of the audioprocessor, the  $\mu$ P can use a simpler 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.

Figure 3: Data Validity on the I<sup>2</sup>C BUS

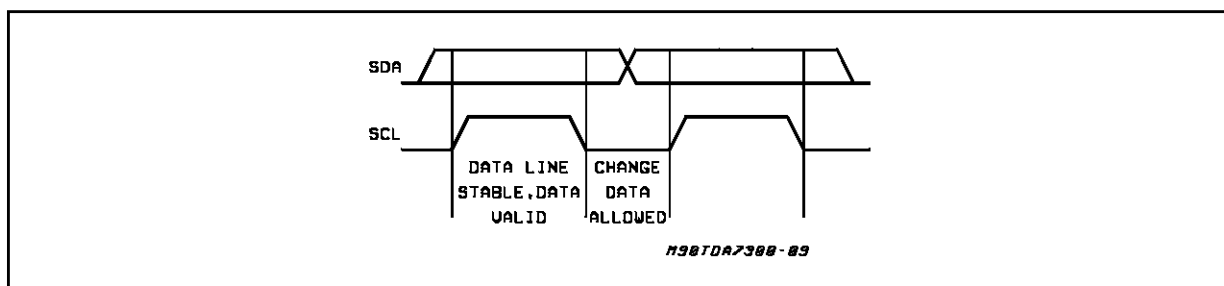


Figure 4: Timing Diagram of I<sup>2</sup>C BUS

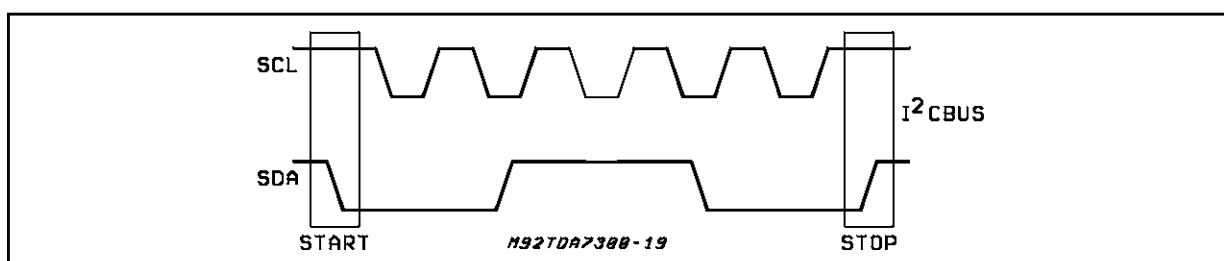
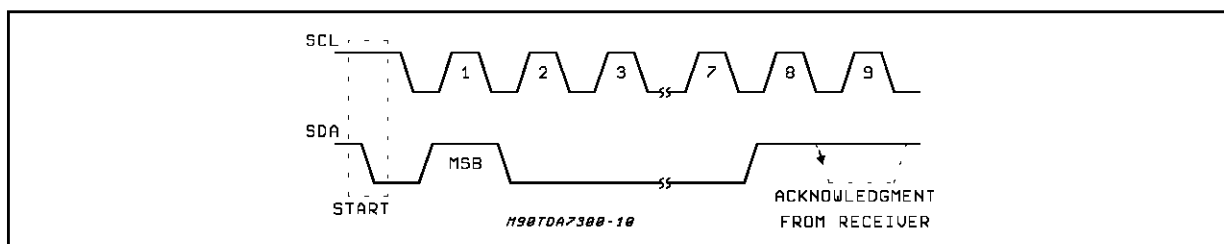


Figure 5: Acknowledge on the I<sup>2</sup>C BUS



## TDA7467

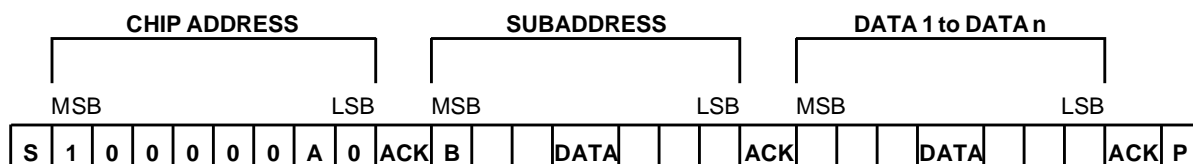
### SOFTWARE SPECIFICATION

Interface Protocol

The interface protocol comprises:

- A start condition (S)

- A chip address byte
- A subaddress bytes
- A sequence of data (N byte + acknowledge)
- A stop condition (P)



ACK = Acknowledge

S = Start

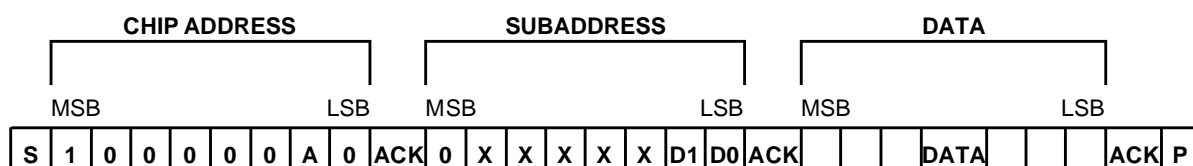
P = Stop

B = Auto Increment

### EXAMPLES

#### No Incremental Bus

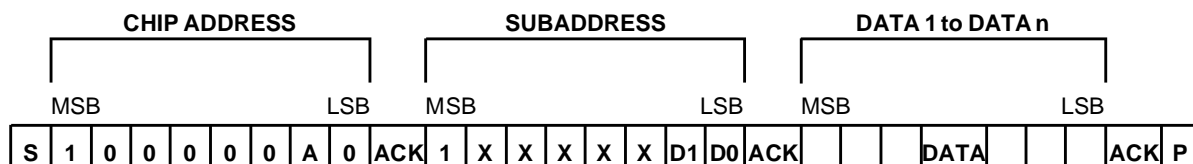
The TDA7467 receives a start condition, the correct chip address, a subaddress with the MSB = 0 (no incremental bus), N-data (all these data concern the subaddress selected), a stop condition.



#### Incremental Bus

The TDA7467 receives a start condition, the correct chip address, a subaddress with the MSB = 1 (incremental bus): now it is in a loop condition with an autoincrease of the subaddress whereas SUBADDRESS from "1XXX1XX" to "1XXX1111" of DATA are ignored.

The DATA 1 concerns the subaddress sent, and the DATA 2 concerns the subaddress plus one sent in the loop etc. and at the end, it receives the stop condition.



**DATA BYTES** (Address = 80(HEX) if ADDR pin is floating, 82(HEX) if ADDR pin is connected to Vs):

**FUNCTION SELECTION:**

The first byte (subaddress)

| MSB |    |    |    |    |    |    | LSB |                        | SUBADDRESS |
|-----|----|----|----|----|----|----|-----|------------------------|------------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  |                        |            |
| B   | X  | X  | X  | X  | X  | 0  | 0   | MODE                   |            |
| B   | X  | X  | X  | X  | X  | 0  | 1   | SRS/SPACE ATTENUATION  |            |
| B   | X  | X  | X  | X  | X  | 1  | 0   | SRS/CENTER ATTENUATION |            |
| B   | X  | X  | X  | X  | X  | 1  | 1   | INPUT ATTENUATION      |            |

B = 1: INCREMENTAL BUS; ACTIVE

B = 0: NO INCREMENTAL BUS

X = INDIFFERENT 0, 1

**INPUT ATTENUATION SELECTION**

| MSB |    |    |    |    |    |    | LSB |                   | INPUT ATTENUATION |
|-----|----|----|----|----|----|----|-----|-------------------|-------------------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  | 0.5 dB STEPS      |                   |
|     |    |    |    |    | 0  | 0  | 0   | 0                 |                   |
|     |    |    |    |    | 0  | 0  | 1   | -0.5              |                   |
|     |    |    |    |    | 0  | 1  | 0   | -1                |                   |
|     |    |    |    |    | 0  | 1  | 1   | -1.5              |                   |
|     |    |    |    |    | 1  | 0  | 0   | -2                |                   |
|     |    |    |    |    | 1  | 0  | 1   | -2.5              |                   |
|     |    |    |    |    | 1  | 1  | 0   | -3                |                   |
|     |    |    |    |    | 1  | 1  | 1   | -3.5              |                   |
|     |    |    |    |    |    |    |     | <b>4 dB STEPS</b> |                   |
|     | 0  | 0  | 0  | 0  |    |    |     | 0                 |                   |
|     | 0  | 0  | 0  | 1  |    |    |     | -4                |                   |
|     | 0  | 0  | 1  | 0  |    |    |     | -8                |                   |
|     | 0  | 0  | 1  | 1  |    |    |     | -12               |                   |
|     | 0  | 1  | 0  | 0  |    |    |     | -16               |                   |
|     | 0  | 1  | 0  | 1  |    |    |     | -20               |                   |
|     | 0  | 1  | 1  | 0  |    |    |     | -24               |                   |
|     | 0  | 1  | 1  | 1  |    |    |     | -28               |                   |
|     | 1  |    |    |    |    |    |     | MUTE              |                   |

INPUT ATTENUATION = 0 ~ -31.5dB

**SRS MODE**

| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | MODE                   |
|----|----|----|----|----|----|----|----|------------------------|
|    |    |    |    |    |    | X  | 0  | SRS OFF (FIX)          |
|    |    |    |    |    |    | X  | 1  | SRS ON                 |
|    |    |    |    |    |    | 0  | 1  | MONO SRS (MONO 3D)     |
|    |    |    |    |    |    | 1  | 1  | STEREO SRS (STEREO 3D) |

RECOMMENDED TO ATTENUATE -3dB ON "SRS OFF"

ie. MONO SRS (MONO 3D): XXXXXX01

## SPACE &amp; CENTER ATTENUATION SELECTION

| MSB |    |    |    |    |    |    | LSB | SPACE & CENTER ATT. |
|-----|----|----|----|----|----|----|-----|---------------------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  | 1 dB STEPS          |
|     |    |    |    |    | 0  | 0  | 0   | 0                   |
|     |    |    |    |    | 0  | 0  | 1   | -1                  |
|     |    |    |    |    | 0  | 1  | 0   | -2                  |
|     |    |    |    |    | 0  | 1  | 1   | -3                  |
|     |    |    |    |    | 1  | 0  | 0   | -4                  |
|     |    |    |    |    | 1  | 0  | 1   | -5                  |
|     |    |    |    |    | 1  | 1  | 0   | -6                  |
|     |    |    |    |    | 1  | 1  | 1   | -7                  |
|     |    |    |    |    |    |    |     | <b>8 dB STEPS</b>   |
|     |    | 0  | 0  | 0  |    |    |     | 0                   |
|     |    | 0  | 0  | 1  |    |    |     | -8                  |
|     |    | 0  | 1  | 0  |    |    |     | -16                 |
|     |    | 0  | 1  | 1  |    |    |     | -24                 |
|     |    | 1  | X  | X  | X  | X  | X   | <b>MUTE</b>         |

X = INDIFFERENT 0, 1

SPACE &amp; CENTER ATTENUATION = 0dB ~ -31dB

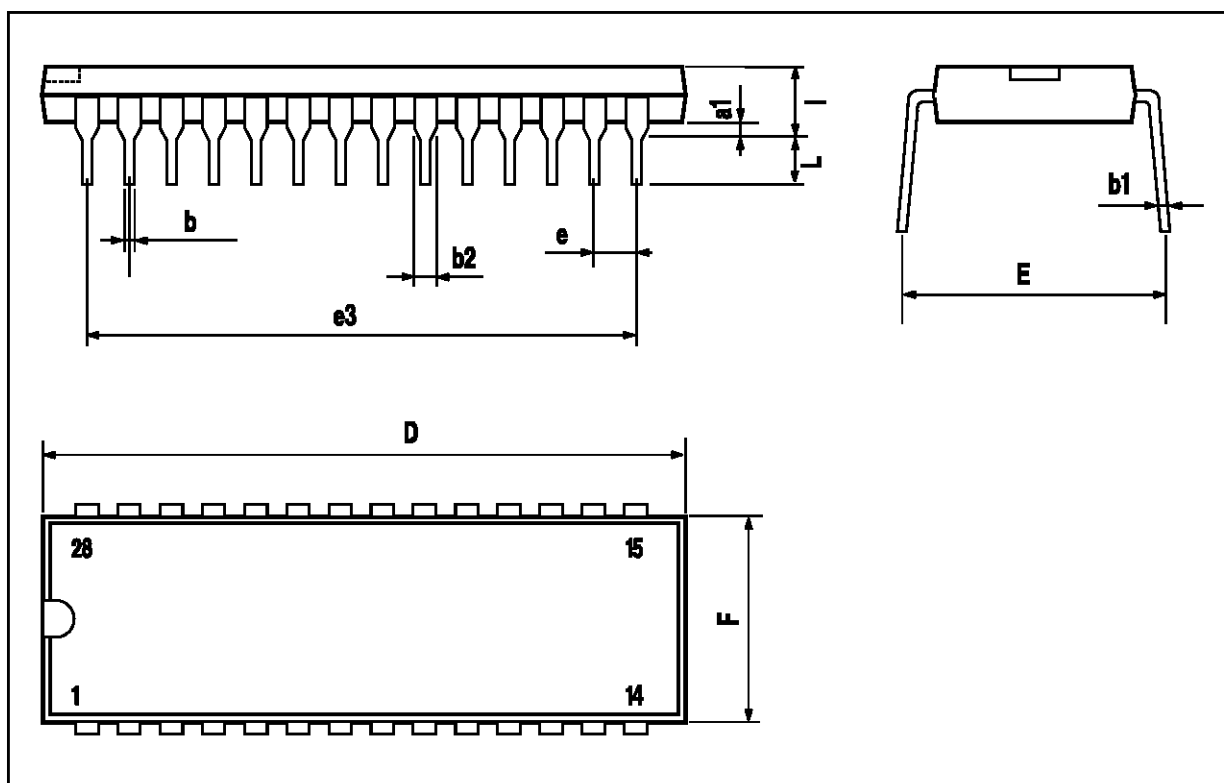
## POWER ON RESET

|                    |            |
|--------------------|------------|
| INPUT              | MUTE       |
| MODE               | OFF (FIX)  |
| SPACE ATTENUATION  | MUTE (MIN) |
| CENTER ATTENUATION | MUTR (MIN) |



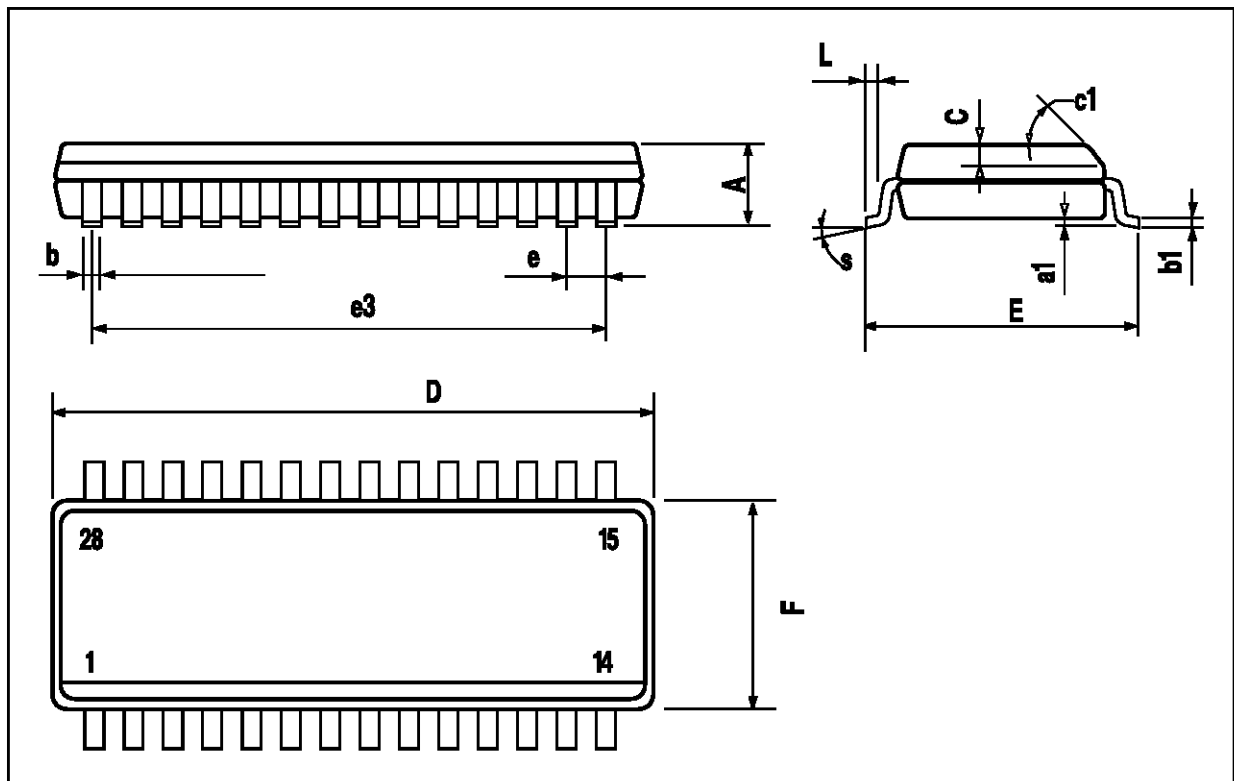
## DIP28 PACKAGE MECHANICAL DATA

| DIM. | mm   |       |       | inch  |       |       |
|------|------|-------|-------|-------|-------|-------|
|      | MIN. | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| a1   |      | 0.63  |       |       | 0.025 |       |
| b    |      | 0.45  |       |       | 0.018 |       |
| b1   | 0.23 |       | 0.31  | 0.009 |       | 0.012 |
| b2   |      | 1.27  |       |       | 0.050 |       |
| D    |      |       | 37.34 |       |       | 1.470 |
| E    | 15.2 |       | 16.68 | 0.598 |       | 0.657 |
| e    |      | 2.54  |       |       | 0.100 |       |
| e3   |      | 33.02 |       |       | 1.300 |       |
| F    |      |       | 14.1  |       |       | 0.555 |
| l    |      | 4.445 |       |       | 0.175 |       |
| L    |      | 3.3   |       |       | 0.130 |       |



SO28 PACKAGE MECHANICAL DATA

| DIM. | mm         |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 2.65  |       |       | 0.104 |
| a1   | 0.1        |       | 0.3   | 0.004 |       | 0.012 |
| b    | 0.35       |       | 0.49  | 0.014 |       | 0.019 |
| b1   | 0.23       |       | 0.32  | 0.009 |       | 0.013 |
| C    |            | 0.5   |       |       | 0.020 |       |
| c1   | 45° (typ.) |       |       |       |       |       |
| D    | 17.7       |       | 18.1  | 0.697 |       | 0.713 |
| E    | 10         |       | 10.65 | 0.394 |       | 0.419 |
| e    |            | 1.27  |       |       | 0.050 |       |
| e3   |            | 16.51 |       |       | 0.65  |       |
| F    | 7.4        |       | 7.6   | 0.291 |       | 0.299 |
| L    | 0.4        |       | 1.27  | 0.016 |       | 0.050 |
| S    | 8° (max.)  |       |       |       |       |       |



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