

- ◇Structure           Silicon Monolithic integrated circuit
- ◇Product name     Audio interface LSI
- ◇Type               BU76310AGU
- ◇Applications     DVC, DSC, etc
- ◇Functions         <Audio part>
  - Stereo 16 bit  $\Delta \Sigma$  CODEC
  - 2-input stereo selector
  - Stereo microphone amplifier with ALC function
  - Stereo line amplifier
  - BTL output speaker amplifier (400mW@8 $\Omega$ , THD+N=10%, VDD=3.3V)
  - 64-step electronic volume with ALC function
  - PLL built-in (Reference clock: 12MHz, 24MHz, 27MHz, 16fs, 32fs, 64fs)
  - <PLL mode>       8kHz, 11.025 kHz, 12 kHz, 16 kHz  
                       22.05 kHz, 24kHz, 32kHz, 44.1kHz, 48 kHz
  - <non-PLL mode>   8kHz  $\sim$  48kHz
  - Master clock output
- Three-line serial interface (power on reset function)
- Audio IF format   MSB First, 2's compliment
- <ADC>   16bit word lengths Left justified, I<sup>2</sup>S DSP
- <DAC>   16bit word lengths Left, Right justified, I<sup>2</sup>S DSP

## ◇Absolute maximum ratings (Ta=25°C)

| Parameter                   | Symbol | Limits                   | Unit | Comment               |
|-----------------------------|--------|--------------------------|------|-----------------------|
| Supply voltage              | VDD    | -0.3~4.5                 | V    | AVDD、DVDD、SPVDD       |
| Input voltage               | VIN    | -0.3~supply voltage +0.3 | V    | keep each limits upon |
| Storage temperature range   | TSTG   | -50~125                  | °C   |                       |
| Operating temperature range | TOPE   | -20~85                   | °C   |                       |
| Power dissipation *1        | PD     | 920*1                    | mW   |                       |

\* 1 : In the case of use at Ta=25°C or more, 9.2mW should be reduced per 1°C.

Radiation resistance design is not arranged.

## ◇Operating conditions (Ta=25°C)

| Parameter      | Symbol | Limits  | Unit | Comment         |
|----------------|--------|---------|------|-----------------|
| Supply voltage | VDD    | 2.7~3.6 | V    | AVDD、DVDD、SPVDD |

(note) AVDD、DVDD、SPVDD、are not needed to be same voltage.

(note) Please do not set SPVDD lower than AVDD-0.3V.

(note) Please do not surpass package permissible loss, when SPVDD is set.

## ◇Electrical characteristics

(Unless specified, Ta=25°C, AVDD=SPVDD=DVDD= 3.3V, AVSS=SPVSS=DVSS= 0V, B.W.=22Hz~22kHz, fs=48kHz, fin=1kHz)

| Parameter                                                                 | Symbol | Limits       |          |              | Unit | Condition          |
|---------------------------------------------------------------------------|--------|--------------|----------|--------------|------|--------------------|
|                                                                           |        | MIN.         | TYP.     | MAX.         |      |                    |
| < Current consumption > #MASTER=0 MCLK=24MHz                              |        |              |          |              |      |                    |
| Power-down mode                                                           | IDDS   | —            | 0.03     | 0.1          | mA   | #PWAP=0            |
| Rec mode/PLL mode                                                         | IDDR   | —            | 10.3     | 19           | mA   | #MDREC=MDPLL=1     |
| Play mode/PLL mode                                                        | IDDP   | —            | 8.4      | 16           | mA   | #MDPB=MDSP=MDPLL=1 |
| <MREG>                                                                    |        |              |          |              |      |                    |
| output voltage                                                            | VOREG  | 0.75AVDD-0.2 | 0.75AVDD | 0.75AVDD+0.2 | V    | 2.2kΩ load         |
| < Logic interface >                                                       |        |              |          |              |      |                    |
| L input voltage                                                           | VIL    | DVSS         | —        | 0.3DVDD      | V    |                    |
| H input voltage                                                           | VIH    | 0.7DVDD      | —        | DVDD         | V    |                    |
| L Input current                                                           | IIL    | —            | —        | 10           | μA   |                    |
| H Input current                                                           | IIH    | —            | —        | 10           | μA   |                    |
| L output voltage                                                          | VOL    | 0            | —        | 0.5          | V    | IOL=-1mA           |
| H output voltage                                                          | VOH    | DVDD-0.5     | —        | DVDD         | V    | IOL=1mA            |
| <REC path (MICIN→ADOUT)> #ALC1=OFF, MGAIN=42dB, MLIM=-37.5dB, DVOL=-4.5dB |        |              |          |              |      |                    |
| Distortion                                                                | THD+N  | 62           | 72       | —            | dB   | DOUT=-10dBFS@1kHz  |
| SNR                                                                       | SNR    | 78           | 88       | —            | dB   | B.W.=JIS-A         |
| <REC path (MICIN→ADOUT)> #ALC1=OFF, MGAIN=48dB                            |        |              |          |              |      |                    |
| Input impedance                                                           | ZIN    | 70           | 100      | 130          | kΩ   |                    |
| Input level                                                               | VIN    | -52          | -50      | -48          | dBV  | DOUT=0dBFS         |
| L/R gain mismatch                                                         | ΔGV    | -1.0         | 0        | +1.0         | dB   | DOUT=0dBFS         |
| Distortion                                                                | THD+N  | 43           | 58       | —            | dB   | DOUT=-6dBFS@1kHz   |
| SNR                                                                       | SNR    | 60           | 66       | —            | dB   | B.W.=JIS-A         |
| L/R separation                                                            | SEPR   | 58           | 83       | —            | dB   | DOUT=-6dBFS@1kHz   |
| ALC1 output level                                                         | DOALC  | —            | -7.3     | —            | dBFS | ALC1=ON            |
| <PB path1 (DAIN→LINEOUT)> #LGAIN=+5dB                                     |        |              |          |              |      |                    |
| Output level                                                              | VO     | -5.5         | -4.0     | -2.5         | dBV  | DIN=-6dBFS         |
| L/R gain mismatch                                                         | ΔGV    | -1.0         | 0        | +1.0         | dB   | DIN=-6dBFS         |
| Distortion                                                                | THD+N  | 70           | 80       | —            | dB   | DIN=-6dBFS@1kHz    |
| SNR                                                                       | SNR    | 82           | 90       | —            | dB   | B.W.=JIS-A         |
| L/R separation                                                            | SEPR   | 80           | 100      | —            | dB   | DIN=-6dBFS@1kHz    |
| <PB path2 (DAIN→EVROUT→SPIN→SPOUT BTL output)> #ALC2=OFF, EVR=-6dB, RL=8Ω |        |              |          |              |      |                    |
| Output level                                                              | VO     | 1.0          | 3.0      | 5.0          | dBV  | DIN=0dBFS          |
| Distortion                                                                | THD+N  | 50           | 60       | —            | dB   | DIN=0dBFS@1kHz     |
| SNR                                                                       | SNR    | 76           | 83       | —            | dB   | B.W.=JIS-A         |
| ALC2 output level                                                         | VOALC  | 1.0          | 3.0      | 5.0          | dBV  | ALC2=ON, EVR=8dB   |
| <PB path3 (BEEPIN→SPOUT BTL output)> #BVOL=13.5dB, RL=8Ω                  |        |              |          |              |      |                    |
| Output level                                                              | GV     | 11.5         | 13.5     | 15.5         | dB   |                    |
| Input impedance                                                           | ZIN    | 25           | 41       | 60           | dB   |                    |

(note) Input level of REC is relative to AVDD.

(note) Output level of PB is relative to AVDD.

(note) Input impedance of BEEPIN is changed to 20kΩ ~ 163kΩ by BVOL.

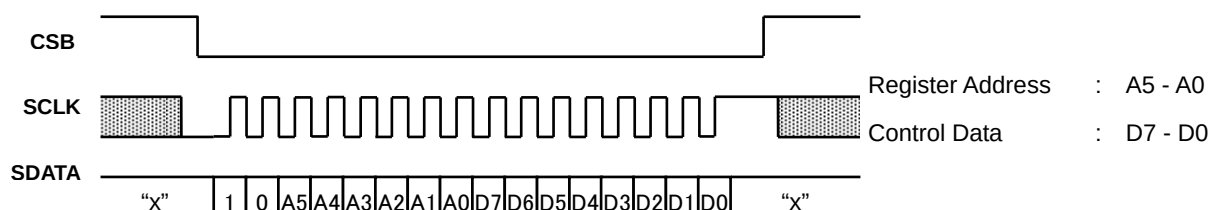
(note) Output level 3.0dBV of SPPOS/SPNEG is about 250mW at RL=8Ω.

## ◇Serial interface

Control commands are entered on the SEN, SCLK, and SDATA pins, using 3 line 16 bit serial input (MSB first).

The input cycle is started on the CSB falling edge, and each bit of data is read in on the SCLK rising edge.

The data is loaded to register on the CSB rising edge.



## ◇Register map

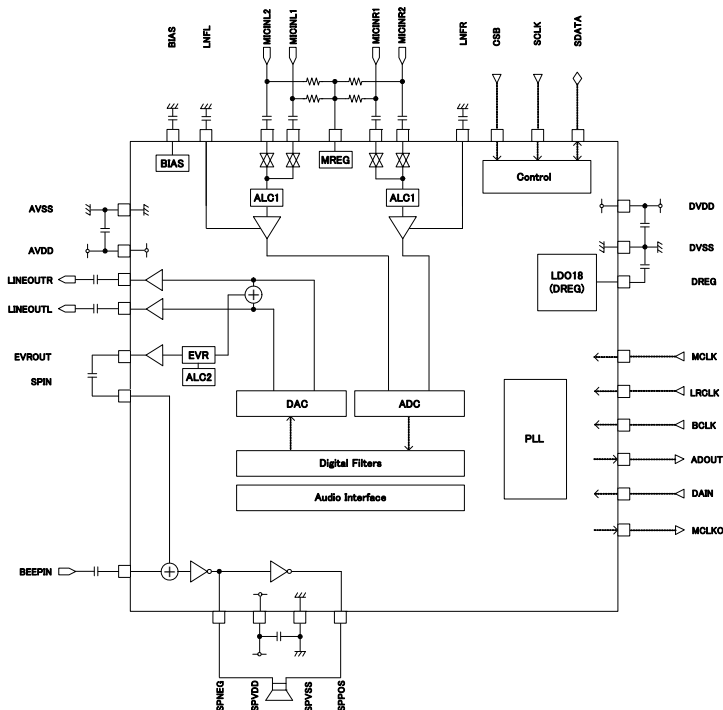
| Address | Register       | D7     | D6     | D5     | D4     | D3     | D2     | D1     | D0     |
|---------|----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| 00H     | Power control  | 0      | PWSV   | PWAP   | PWMRG  | 0      | 0      | 0      | PWDRG  |
| 01H     | Power control  | 0      | COMENB | 0      | 0      | MDSP   | MDPB   | MDREC  | MDPLL  |
| 03H     | Gain control   | 0      | 0      | ADA    | 0      | 0      | LGAIN  | MGAIN1 | MGAIN0 |
| 04H     | Gain control   | SLMIN1 | SLMIN0 | 0      | 0      | MUSP   | MUBSP  | MULO   | MUDVL  |
| 05H     | Clock control  | FMCK1  | FMCK0  | FBCK1  | FBCK0  | 0      | DIF2   | DIF1   | DIF0   |
| 06H     | Clock control  | 0      | FRCK2  | FRCK1  | FRCK0  | SFS1   | SFS0   | DIV1   | DIV0   |
| 07H     | Clock control  | MASTER | BFPD   | 0      | DLEN   | 0      | MCKO   | 0      | 0      |
| 08H     | ALC control    | 0      | MDALC1 | MDEV1  | MDEV0  | 0      | 0      | 0      | MDDVL  |
| 09H     | ALC control    | ATMC1  | ATMC0  | RCMC1  | RCMC0  | ATSP1  | ATSP0  | RCSP1  | RCSP0  |
| 0AH     | ALC control    | RC2MC1 | RC2MC0 | CVRG1  | CVRG0  | RCLM   | 0      | 0      | 0      |
| 0BH     | Time control   | RINI2  | RINI1  | RINIO  | PINI1  | PINIO  | 0      | DVLT   | EVRT   |
| 0CH     | Volume control | 0      | MLIM6  | MLIM5  | MLIM4  | MLIM3  | MLIM2  | MLIM1  | MLIM0  |
| 0DH     | Filter control | 0      | 0      | DEM1   | DEM0   | HPFR3  | HPFR2  | HPFR1  | HPFR0  |
| 0EH     | Volume control | DVOL7  | DVOL6  | DVOL5  | DVOL4  | DVOL3  | DVOL2  | DVOL1  | DVOL0  |
| 0FH     | Volume control | 0      | 0      | EVR5   | EVR4   | EVR3   | EVR2   | EVR1   | EVR0   |
| 10H     | Volume control | 0      | 0      | SPVOL1 | SPVOL0 | 0      | BVOL2  | BVOL1  | BVOL0  |
| 12H     | Fade control   | 0      | 0      | 0      | 0      | DVLSK  | DVLT2  | DVLT1  | DVLT0  |
| 13H     | ALC control    | 0      | 0      | 0      | 0      | 0      | ATTO   | 0      | 0      |
| 17H     | Filter control | DFMRP  | OLDFM  | 0      | DFMEN4 | DFMEN3 | DFMEN2 | DFMEN1 | DFMEN0 |
| 18H     | Filter control | DF0M1  | DF0M0  | DF0A13 | DF0A12 | DF0A11 | DF0A10 | DF0A9  | DF0A8  |
| 19H     | Filter control | DF0A7  | DF0A6  | DF0A5  | DF0A4  | DF0A3  | DF0A2  | DF0A1  | DF0A0  |
| 1AH     | Filter control | 0      | 0      | DF0B13 | DF0B12 | DF0B11 | DF0B10 | DF0B9  | DF0B8  |
| 1BH     | Filter control | DF0B7  | DF0B6  | DF0B5  | DF0B4  | DF0B3  | DF0B2  | DF0B1  | DF0B0  |
| 1CH     | Filter control | DF1M1  | DF1M0  | DF1A13 | DF1A12 | DF1A11 | DF1A10 | DF1A9  | DF1A8  |
| 1DH     | Filter control | DF1A7  | DF1A6  | DF1A5  | DF1A4  | DF1A3  | DF1A2  | DF1A1  | DF1A0  |
| 1EH     | Filter control | 0      | 0      | DF1B13 | DF1B12 | DF1B11 | DF1B10 | DF1B9  | DF1B8  |
| 1FH     | Filter control | DF1B7  | DF1B6  | DF1B5  | DF1B4  | DF1B3  | DF1B2  | DF1B1  | DF1B0  |
| 20H     | Filter control | DF2M1  | DF2M0  | DF2A13 | DF2A12 | DF2A11 | DF2A10 | DF2A9  | DF2A8  |
| 21H     | Filter control | DF2A7  | DF2A6  | DF2A5  | DF2A4  | DF2A3  | DF2A2  | DF2A1  | DF2A0  |
| 22H     | Filter control | 0      | 0      | DF2B13 | DF2B12 | DF2B11 | DF2B10 | DF2B9  | DF2B8  |
| 23H     | Filter control | DF2B7  | DF2B6  | DF2B5  | DF2B4  | DF2B3  | DF2B2  | DF2B1  | DF2B0  |
| 24H     | Filter control | DF3M1  | DF3M0  | DF3A13 | DF3A12 | DF3A11 | DF3A10 | DF3A9  | DF3A8  |
| 25H     | Filter control | DF3A7  | DF3A6  | DF3A5  | DF3A4  | DF3A3  | DF3A2  | DF3A1  | DF3A0  |
| 26H     | Filter control | 0      | 0      | DF3B13 | DF3B12 | DF3B11 | DF3B10 | DF3B9  | DF3B8  |
| 27H     | Filter control | DF3B7  | DF3B6  | DF3B5  | DF3B4  | DF3B3  | DF3B2  | DF3B1  | DF3B0  |
| 28H     | Filter control | DF4M1  | DF4M0  | DF4A13 | DF4A12 | DF4A11 | DF4A10 | DF4A9  | DF4A8  |
| 29H     | Filter control | DF4A7  | DF4A6  | DF4A5  | DF4A4  | DF4A3  | DF4A2  | DF4A1  | DF4A0  |
| 2AH     | Filter control | 0      | 0      | DF4B13 | DF4B12 | DF4B11 | DF4B10 | DF4B9  | DF4B8  |
| 2BH     | Filter control | DF4B7  | DF4B6  | DF4B5  | DF4B4  | DF4B3  | DF4B2  | DF4B1  | DF4B0  |

(note) Do not write to the address except for the above.

#### ◇Pin Functional Descriptions

| No    | Pin name       | Function             | No       | Pin name | Function                        |
|-------|----------------|----------------------|----------|----------|---------------------------------|
| C6    | LNFR           | NF input for MIC Rch | E5       | SPVDD    | SP power supply                 |
| D4    | MICINR2        | MIC Rch input2       | F5       | SPPOS    | SP positive output              |
| D3    | MICINR1        | MIC Rch input1       | E4       | BEEPIN   | BEEP input                      |
| E2    | MREG           | MIC power supply     | B2       | MCLKO    | CODEC master clock input        |
| E1    | MICINL1        | MIC Lch input1       | B6       | DREG     | LDO18 output (1.8V)             |
| D5    | MICINL2        | MIC Lch input2       | B1       | DVDD     | Digital power supply            |
| D2    | LNFL           | NF input for MIC Lch | A5       | DAIN     | CODEC DA serial data input      |
| D1    | BIAS (1/2AVDD) | Bias (1/2AVDD)       | A2       | ADOUT    | CODEC AD serial data output     |
| C1,F1 | AVSS           | Analog ground        | A3       | BCLK     | CODEC bit clock in/output       |
| F2    | AVDD           | Analog power supply  | B3       | LRCLK    | CODEC LR clock in/output        |
| C5    | LINEOUTR       | LINE Rch output      | A4       | MCLK     | CODEC master clock output       |
| F3    | LINEOUTL       | LINE Lch output      | C2,A1,A6 | DVSS     | Digital ground                  |
| F4    | EVROUT         | EVR output           | B5       | SDATA    | 3-wire serial data input        |
| E3    | SPIN           | SP input             | B4       | SCLK     | 3-wire serial clock input       |
| D6    | SPNEG          | SP negative output   | C4       | CSB      | 3-wire serial chip select input |
| E6,F6 | SPVSS          | SP ground            | -        | -        | -                               |

## ◇Block diagram・External dimensions



(Note) Place the capacitors for AVDD, BIAS pins close to each

Figure1 Block diagram

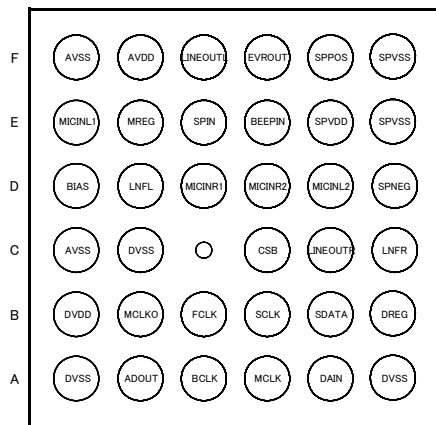


Figure2 Pin assign (bottom face)

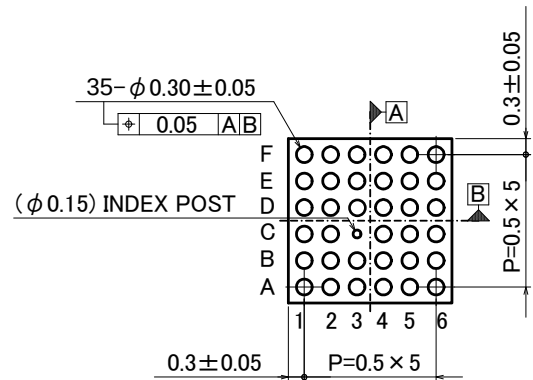
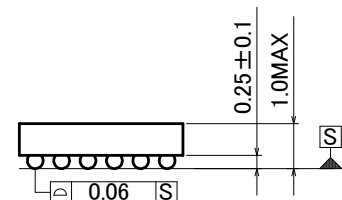
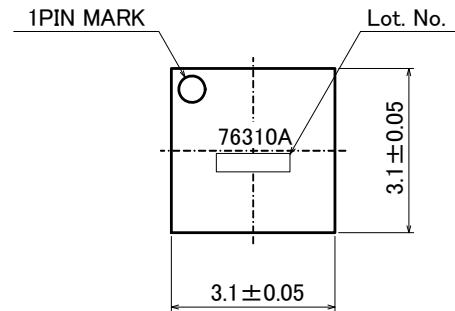


Figure3 External dimension (Unit: mm)

## ◇Caution

- (1) About absolute maximum rating  
When the absolute maximum rating such as the applied voltage and the ranges of the operating temperature is exceeded, LSI might be destroyed. Please apply neither voltage nor the temperature that exceeds the absolute maximum rating.  
Please execute physical measures for safety such as fuse when it is thought to exceed the absolute maximum rating, and examine it so that the condition to exceed the absolute maximum rating is not applied to LSI.
- (2) About GND Voltage  
In any state of operation must be the lowest voltage about the voltage of the terminal GND. Please actually confirm the voltage of each terminal is not a voltage that is lower than the terminal GND including excessive phenomenon.
- (3) About design of overheating malfunction preventive circuit  
Please design overheating malfunction preventive circuit with an enough margin in consideration of a permissible loss in the state of using actually.
- (4) About the short between terminals and the mounting by mistake  
Please note the direction and the gap of position of LSI enough about LSI when you mount on the substrate. LSI might be destroyed when mounting by mistake and energizing. Moreover, LSI might be destroyed when short-circuited by entering of the foreign substances between the terminal and GND, between terminals, between the terminal and the power supply of LSI.
- (5) About operation in strong electromagnetic field  
Use in strong electromagnetic field has the possibility of malfunctioning and evaluate it enough, please.
- (6) Please note not to be beyond the package permissible range, When SPVDD is set.
- (7) No guarantee connection for A1, A6, F1 and F6. Please connect another pin of same name, too.
- (8) About operation in strong light  
Use in strong light has the possibility of malfunctioning. Please shield from the light, if needed.

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