

# OKI Semiconductor

## ML63326

4-Bit Microcontroller with built-in Voice Synthesis and 1024-Dot LCD Drivers



### GENERAL DESCRIPTION

The ML63326 is a low power 4-bit microcontroller which incorporates the OKI original CPU core nX-4/250 and provides a minimum instruction execution time of  $1\mu\text{s}$  (@2MHz).

It contains 24K-word program memory, 1536-nibble data memory, 4-bit input port, four 4-bit output ports, five 4-bit and 2-bit input-output ports, shift register, LCD driver for up to 1024 segments, and voice synthesis, including 1 megabit mask ROM for speech data, a 12-bit D/A converter and low-pass filter internally. Speech ROM size can be expanded externally with further 4 megabits. The ML63326 is suitable for applications such as games, toys, clocks etc. which use an LCD display and voice synthesis.

### FEATURES

- Rich instruction set
  - 439 instructions
  - Transfer, rotate, increment, decrement, arithmetic operations, comparison, logic operations, mask operations, bit operations, ROM table reference, external memory transfer, stack operations, flag operations, branch, conditional branch, call/return, control.
- Rich selection of addressing modes
  - Indirect addressing of four data memory types, with current bank register, extra bank register, HL register and XY register.
  - Data memory bank internal direct addressing mode.
- Processing speed
  - Two clocks per machine cycle, with most instructions executed in one machine cycle.
  - Minimum instruction execution time :  $61\mu\text{s}$  ( @32.768kHz system clock )  
 $1\mu\text{s}$  ( @2MHz system clock: 1/2 of high-speed clock )
- Clock generation circuit
  - Low-speed clock: : 32.768kHz crystal oscillator,  
or 32kHz  $\pm 40\%$  ( @1M $\Omega \pm 10\%$  ), RC oscillator (by mask option)
  - High-speed clock: : 4MHz (max.) crystal oscillator,  
or 2MHz  $\pm 40\%$  ( @20k $\Omega \pm 5\%$  ) RC oscillator (by software selection)
- Program memory space
  - 24K words
  - Basic instruction length is 16 bits / 1 word
- Data memory space
  - 1536 nibbles
- External data memory space
  - 64kbyte ( expandable )
- Stack level
  - Call stack level : 16 levels
  - Register stack level : 16 levels

- I/O ports

Input ports: Selectable as input with pull-up resistance/ input with pull-down resistor / high-impedance input  
Output ports: Selectable as P-channel open drain output / N-channel open drain output / CMOS output / high-impedance output

Input-output ports: Selectable as input with pull-up resistance / input with pull-down resistance / high-impedance input  
Selectable as P-channel open drain output / N-channel open drain output / CMOS output / high-impedance output

Can be interfaced with external peripherals that use a different power supply than this device uses.

Number of ports:

Input ports : 1 port × 4 bits  
Output port : 4 ports × 4 bits  
Input-output port : 5 ports × 4 bits and 1 port × 2 bits

- Voice synthesis

Algorithm : 4-bit ADPCM / Oki non-linear 8-bit PCM / 8-bit PCM

Voice synthesis data memory:

Internal ROM : 1 Mbit mask ROM (128k bytes)  
External ROM : 4 Mbit ROM (512k bytes max.)

Sampling frequencies (at clock frequency 4.096MHz)

4.0kHz, 5.3kHz, 6.4kHz, 8.0kHz, 10.7kHz, 12.8kHz, 16.0kHz

12-bit D/A converter

Low-pass filter

- Melody output function

Two systems (one is in voice synthesis portion, the other is in microcontroller portion)

MD, MDB output ports are selected from two systems

Melody output in voice synthesis portion can put out to AOUT/AOUTB output ports

- LCD driver

Number of segments : 1024 Max. (64SEG × 16COM)

1/1 to 1/16 duty

1/4 or 1/5 bias (regulator built-in)

Selectable as all-on mode/ all-off mode/ power down mode/ normal display mode

Adjustable contrast

- Reset function

Reset through RESET pin

Power-on reset

Reset to low-speed oscillation halt

- Battery check

Low-voltage supply check

Criterion voltage : Can be selected as 2.40 ±0.20V

- Timers and Counters

8-bit timer × 4

Selectable to auto-reload mode/ capture mode/ clock frequency measurement mode

Watchdog timer × 1

100Hz timer × 1

15-bit time-base counter × 1

1, 2, 4, 8, 16, 32, 64, and 128Hz signals can be read

- Shift register
    - Shift clock :  $1 \times$  or  $1/2 \times$  system clock, external clock
    - Data length : 8 bits
  - Interrupt sources
    - External interrupt : 3
    - Internal interrupt : 12 (watchdog timer  $\times$  1, time base  $\times$  4, 100Hz timer  $\times$  1, timer  $\times$  4, shift-register  $\times$  1, melody  $\times$  1), (watchdog timer interrupt is a nonmaskable interrupt )
  - Operating voltage
    - +2.0 to 5.5V
  - Package
    - Chip : ( Product name : ML63326 - xxx )  
xxx indicates a code number.
    - Chip size : TBA
    - Chip thickness :  $350 \mu\text{m}$  (typ.)
- Fig.1 shows PAD layout image.
- Minimum pad pitch :  $xxx \mu\text{m}$  (a)
  - Bonding pad size :  $100 \mu\text{m} \times 100 \mu\text{m}$  (b  $\times$  c)
  - Pad size :  $110 \mu\text{m} \times 110 \mu\text{m}$  (d  $\times$  e)

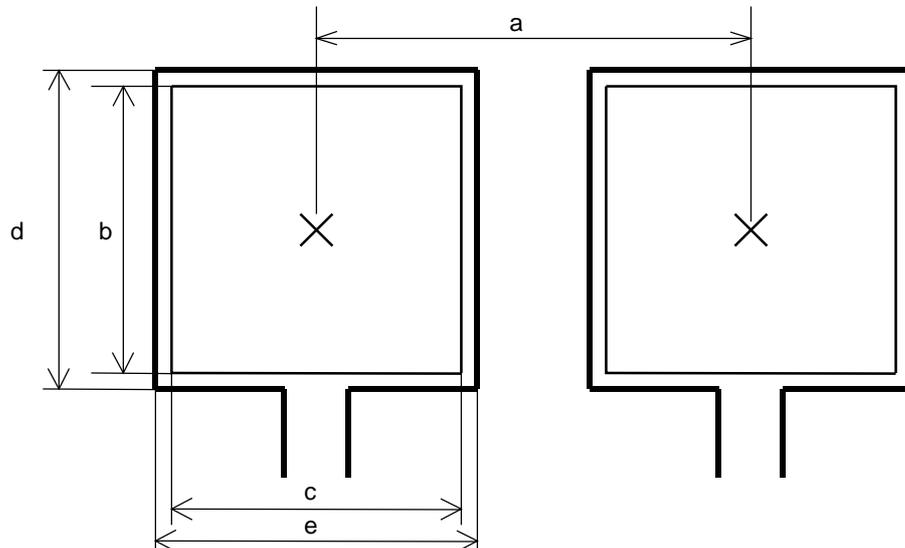


Fig.1 PAD layout

## BLOCK DIAGRAM

An asterisk (\*) indicates the port secondary function.    indicates that the power is supplied to the circuits corresponding to the signal names inside    from  $V_{DD1}$  (power supply for interface).

