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 1μs (@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   : 61μs (@32.768kHz system clock)
                                                1μs   (@2MHz system clock: 1/2 of high-speed clock)

- Clock generation circuit

    Low-speed clock: : 32.768kHz crystal oscillator,
                                                or 32kHz ±40% (@1MΩ ±10%), RC oscillator (by mask option)
    High-speed clock: : 4MHz (max.) crystal oscillator,
                                                or 2MHz ±40% (@20kΩ ±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 its
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 microcontoroller 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 x 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 µm (typ.)

       Fig.1 shows PAD layout image.
       Minimum pad pitch   : xxx µm (a)
       Bonding pad size   : 100µm $\times$ 100µm (b $\times$ c)
       Pad size   : 110µm $\times$ 110µm (d $\times$ e)
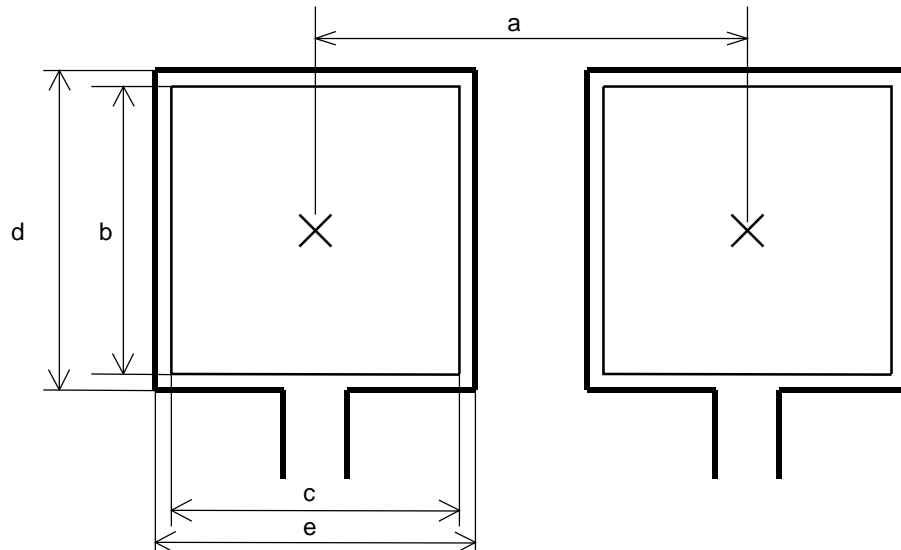

Fig.1   PAD layout

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_{DDI} (power supply for interface) .

The voice synthesis portion