

1.1 Overview

1.1.1 Overview

The MN101E series of 8-bit single-chip microcomputers (the memory expansion version of MN101C series) incorporate multiple types of peripheral functions. This chip series is well suited for camera, VCR, MD, TV, CD, LD, printer, telephone, home automation, pager, air conditioner, PPC, fax machine, music instrument and other applications.

This LSI brings to embedded microcomputer applications flexible, optimized hardware configurations and a simple efficient instruction set. The MN101E30 series have an internal 928 KB (maximum) of ROM and 8 KB (maximum) of RAM. Peripheral functions include 6 external interrupts, 30 internal interrupts including NMI, 9 timer counters, 6 sets of serial interfaces, A/D converter, D/A converter, LCD driver, watchdog timer, 2 sets of automatic data transfer, synchronous output function and buzzer output. The configuration of this microcomputer is well suited for application as a system controller in camera, timer selector for VCR, CD player, or minicomponent, and also suited for audio reproduction with a high-precision D/A converter.

With three oscillation system (high frequency: max. 20 MHz / low frequency: 32.768 kHz and PLL: frequency multiplier of high frequency) contained on the chip, the system clock can be switched to high frequency input (high speed mode), PLL input (PLL mode), or to low frequency input (low speed mode). The system clock is generated by dividing the oscillation clock. The best operation clock for the system can be selected by switching its frequency by software. High speed mode has the normal mode based on $f_{pll}/2$ which is half clock generated from an original oscillation and PLL, and the double speed mode based on f_{pll} which is clock generated from an original oscillation without dividing.

A machine cycle (min. instructions execution) in the normal mode is 100 ns when f_{osc} is 20 MHz (at the time that PLL is not used). A machine cycle in the double speed mode is 50 ns when f_{osc} is 20 MHz. A machine cycle in the PLL mode is 50 ns (maximum). The package is 100-pin QFP, LQFP.

1.1.2 Product Summary

This manual describes the following models of the MN101E30 series. These products have identical functions, and their memory capacity and type are shown below.

Table:1.1.1 Product Summary

Model	ROM Size	RAM Size	Classification	Package
MN101E30N	508 KB	8 KB	Mask ROM version	LQFP100-P-1414C QFP100-P-1818B
MN101E30R	928 KB	8 KB	Mask ROM version	QFP100-P-1818B
MN101EF30R	928 KB	8 KB	Flash EEPROM version	LQFP100-P-1414 QFP100-P-1818B



This manual is described with a focus on MN101E30N.

1.2 Hardware Functions

■ Feature

- ROM Capacity: 508/928 KB
- RAM Capacity: 8 KB

- Package: 100pin LQFP (14 mm square, 0.5 mm pitch)
100pin QFP (18 mm square, 0.65 mm pitch)

- Machine Cycle:
 - High speed mode
0.05 ms/ 20 MHz (2.2 V to 5.5 V)
 - PLL mode
0.05 μ s/ 20 MHz (2.2 V to 5.5 V)
 - Low speed mode
62.5 μ s/16 kHz (2.2 V to 5.5 V)

- Clock Gear: Operation speed of system clock is variable by changing the frequency.

- Multiplied Clock: High-speed frequency clock (f_{osc}) can be multiplied by 2, 3, 4, 5, 6, 8 and 10.

- Memory bank:
 - Data memory space is expanded by the bank system.
 - Bank for the source address/Bank for the destination address.

- ROM correction: Correcting address designation: up to 7 addresses possible

- Operation Modes:
 - NORMAL mode (High speed mode)
 - PLL mode
 - SLOW mode (Low speed mode)
 - HALT mode
 - STOP mode
 - (The operation clock can be switched in each mode.)

- Operating Voltage: 2.2 V to 5.5 V

- Operating Temperature: -40°C to +85°C

- Interrupt: 36 levels

<Watchdog timer>

- NMI-Watchdog timer overflow

<Timer interrupts>

- TM0IRQ-Timer 0 interrupt (8-bit timer)
- TM1IRQ-Timer 1 interrupt (8-bit timer)
- TM2IRQ-Timer 2 interrupt (8-bit timer)
- TM3IRQ-Timer 3 interrupt (8-bit timer)
- TM4IRQ-Timer 4 interrupt (8-bit timer)
- TM6IRQ-Timer 6 interrupt (8-bit timer)
- TBIRQ-Clock timer interrupt
- TM7IRQ-Timer 7 interrupt (16-bit timer)
- T7OC2IRQ- Timer 7 interrupt (16-bit timer)
- TM8IRQ-Timer 8 interrupt (16-bit timer)
- T8OC2IRQ- Timer 8 interrupt (16-bit timer)
- TM9IRQ-Timer 9 interrupt (16-bit timer)
- T9OC2IRQ- Timer 9 interrupt (16-bit timer)

<Serial interrupts>

- SC0TIRQ-Serial interface 0 interrupt
- SC0RIRQ-Serial interface 0 UART reception interrupt (peripheral function group interrupt)
- SC1TIRQ-Serial interface 1 interrupt
- SC1RIRQ-Serial interface 1 UART reception interrupt (peripheral function group interrupt)
- SC2TIRQ-Serial interface 2 interrupt
- SC2RIRQ-Serial interface 2 UART reception interrupt
- SC3TIRQ-Serial interface 3 interrupt
- SC3RIRQ-Serial interface 3 UART reception interrupt (peripheral function group interrupt)
- SC4TIRQ- Serial interface 4 interrupt
- SC4SIRQ- Serial interface 4 stop condition interrupt (peripheral function group interrupt)
- SC5TIRQ- Serial interface 5 interrupt (peripheral function group interrupt)

<A/D conversion end>

- ADIRQ-AD conversion end (peripheral function group interrupt)

<Automatic Transfer Controller interrupts>

- ATC0IRQ-ATC0 interrupt (peripheral function group interrupt)
- ATC1IRQ-ATC1 interrupt (peripheral function group interrupt)

<External interrupts> Edge selectable

- IRQ0:External interrupt (AC zero-cross detector, With/Without noise filter)
- IRQ1:External interrupt (AC zero-cross detector, With/Without noise filter)
- IRQ2:External interrupt (Both edges interrupt)
- IRQ3:External interrupt (Both edges interrupt)
- IRQ4:External interrupt (Both edges interrupt)
- IRQ5:External interrupt (Key scan interrupt only)

<Audio interrupts>

- Audio reproduction end interrupt
- Audio phrase end interrupt

- Timer Counter: 11 timers All timer counters generate interrupt (10 can be operated independently)

- 8-bit timer for general use: 5 sets
- 8-bit free-running timer: 1 set
- Time base timer: 1 set
- 16-bit timer for general use: 3 sets
- Simple 8-bit timer: 1 set

Timer 0 (8-bit timer for general use)

- Square wave output (timer pulse output), added pulse(2-bit) system PWM output (can be output to large current pin TM0IOB), event count, remote control carrier output, simple pulse with measurement
- Clock source
fpll, fpll/4, fpll/16, fpll/32, fpll/64, fpll/128, fs/2, fs/4, fs/8, fx, external clock, TimerA output
- Real timer output control
Control the timer (PWM) output by the falling edge of external interrupt 0 (IRQ0) with the follow 3 value; "High"-fixed, "LOW"-fixed and "Hi-Z"-fixed

Timer 1 (8-bit timer for general use)

- Square wave output (timer pulse output), event count, 16-bit cascade connected (timer0, 1) timer synchronous output event

- Clock source
fpll, fpll/4, fpll/16, fpll/32, fpll/64, fpll/128, fs/2, fs/4, fs/8, fx, external clock, TimerA output

Timer 2 (8-bit timer for general use)

- Square wave output (timer pulse output), added pulse(2-bit) system PWM output (can be output to large current pin TM2IOB), event count, simple pulse with measurement, 24-bit cascade connected (timer0, 1) timer synchronous output event
- Clock source
fpll, fpll/4, fpll/16, fpll/32, fpll/64, fpll/128, fs/2, fs/4, fs/8, fx, external clock, TimerA output
- Real timer output control
Control the timer (PWM) output by the falling edge of external interrupt 0 (IRQ0) with the follow 3 value; "High"-fixed, "LOW"-fixed and "Hi-Z"-fixed

Timer 3 (8-bit timer for general use)

- Square wave output (timer pulse output), event count, remote control carrier output, 16bit cascade connected (timer2), 32-bit cascade connected (timer0, 1, 2)
- Clock source
fpll, fpll/4, fpll/16, fpll/32, fpll/64, fpll/128, fs/2, fs/4, fs/8, fx, external clock, TimerA output

Timer 4 (8-bit timer for general use)

- Square wave output (timer pulse output), added pulse(2-bit) system PWM output, event count, serial transfer clock, simple pulse measurement
- Clock source
fpll, fpll/4, fpll/16, fpll/32, fpll/64, fpll/128, fs/2, fs/4, fs/8, fx, external clock, TimerA output

Timer 6 (8-bit free-running timer, Time base timer)

8-bit free-running timer

- Clock source
fpll, fpll/2¹², fpll/2¹³, fs, fx, fx/2¹², fx/2¹³

Time base timer

- Interrupt generation cycle
fpll/2⁷, fpll/2⁸, fpll/2⁹, fpll/2¹⁰, fpll/2¹³, fpll/2¹⁵, fx/2⁷, fx/2⁸, fx/2⁹, fx/2¹⁰, fx/2¹³, fx/2¹⁵

Timer 7 (16-bit timer for general use)

- Clock source
fpll, fpll/2, fpll/4, fpll/16, fs, fs/2, fs/4, fs/16
1/1, 1/2, 1/4, 1/16 of the external clock, TimerA output
- Hardware organization
Compare register with double buffer: 2 sets

Input capture register: 1 set
Timer interrupt: 2 vectors

- Timer functions

Square wave output (Timer pulse output), High precision PWM output (Cycle/Duty continuous changeable), IGBT output (Cycle/Duty continuous changeable) can be output to large current pin TM7IOB

Timer synchronous output, event count, Input capture function (Both edges can be operated)

-Real timer output control

Control the timer (PWM) output by the falling edge of external interrupt 0 (IRQ0) with the follow 3 value; "High"-fixed, "LOW"-fixed and "Hi-Z"-fixed

Timer 8 (16-bit timer for general use)

-Clock source

fpll, fpll/2, fpll/4, fpll/16, fs, fs/2, fs/4, fs/16
1/1, 1/2, 1/4, 1/16 of the external clock, TimerA output

-Hardware organization

Compare register with double buffer: 2 sets
Input capture register: 1 set
Timer interrupt: 2 vectors

-Timer functions

Square wave output (Timer pulse output), High precision PWM output (Cycle/Duty continuous changeable) can be output to large current pin TM8IOB, event count, pulse width measurement, input capture (Both edge available), 32-bit cascade connected (Timer7, 8), 32-bit PWM output, Input capture is available at 32-bit cascade

Timer 9 (16-bit timer for general use)

-Clock source

fpll, fpll/2, fpll/4, fpll/16, fs, fs/2, fs/4, fs/16, 1/1, 1/2, 1/4, 1/16 of the external clock
TimerA output

-Hardware organization

Compare register with double buffer: 2 sets
Input capture register: 1 set
Timer interrupt: 2 vectors

-Timer functions

Square wave output (Timer pulse output), High precision PWM output (Cycle/Duty continuous changeable) can be output to large current pin TM9IOB, event count, pulse width measurement, input capture (Both edge available)

-Real timer output control

Control the timer (PWM) output by the falling edge of external interrupt 0 (IRQ0) with the follow 3 value; "High"-fixed, "LOW"-fixed and "Hi-Z"-fixed

TimerA output (Simple timer counter A)

Clock output for peripheral function

- Watchdog timer
 - Time-out cycle can be selected from $f_s/2^{16}$, $f_s/2^{18}$, $f_s/2^{20}$
 - On detection of errors, hard reset is done inside LSI.

- Synchronous output function
 - Timer synchronous output, interrupt synchronous output Port 8 outputs the latched data, on the event timing of the synchronous output signal of timer 1, 2, or 7, or of the external interrupt 2 (IRQ2).

- Buzzer Output/Reverse Buzzer Output:
 - Output frequency can be selected from $f_{pll}/2^9$, $f_{pll}/2^{10}$, $f_{pll}/2^{11}$, $f_{pll}/2^{12}$, $f_{pll}/2^{13}$, $f_{pll}/2^{14}$, $f_x/2^3$, $f_x/2^4$.

- Remote Control Carrier Output:
 - A remote control carrier output with duty cycle of 1/2 or 1/3 of timer 0 or timer 3 output are available.

- A/D Converter: 10-bit x 12 channels

- D/A Converter: 8-bit x 4 channels

- Data automatic transfer: 2 systems
 - ATC0
 - Data is transferred automatically in all memory space
 - External request/internal event request/software request
 - Maximum transfer cycles are 255
 - Support continuous serial transmission / reception.
 - Burst transfer function (Urgent stop of interrupts is contained.)
 - ATC1
 - Data is transferred automatically in all memory space
 - External request/internal event request/software request
 - Maximum transfer cycles are 255
 - Support continuous serial transmission / reception.
 - Burst transfer function (Urgent stop of interrupts is contained.)

- Serial Interface: 6 channels

Serial 0 (Full duplex UART / Synchronous serial interface)

Synchronous serial interface

- Transfer clock source
fpll/2, fpll/4, fpll/16, fpll/64, fs/2, fs/4, Timer0,1,2,3,4 and A output, external clock
- MSB/LSB can be selected as the first bit to be transferred. An arbitrate transfer size from 1 to 8 bits can be selected.
- Sequence transmission, reception or both are available.

Full duplex UART (Baud rate timer, Timer0,1,2,3,4 and A)

- Parity check, Overrun error / Framing error detection
- Transfer size 7 to 8 bits can be selected.

Serial 1 (Full duplex UART / Synchronous serial interface)

Synchronous serial interface

- Transfer clock source
fpll/2, fpll/4, fpll/16, fpll/64, fs/2, fs/4, Timer0,1,2,3,4 and A output, external clock
- MSB/LSB can be selected as the first bit to be transferred. An arbitrate transfer size from 1 to 8 bits can be selected.
- Sequence transmission, reception or both are available.

Full duplex UART (Baud rate timer, Timer0,1,2,3,4 and A)

- Parity check, Overrun error / Framing error detection
- Transfer size 7 to 8 bits can be selected.

Serial 2 (Full duplex UART / Synchronous serial interface)

Synchronous serial interface

- Transfer clock source
fpll/2, fpll/4, fpll/16, fpll/64, fs/2, fs/4, Timer0,1,2,3,4 and A output,external clock
- MSB/LSB can be selected as the first bit to be transferred. An arbitrate transfer size from 1 to 8 bits can be selected.
- Sequence transmission, reception or both are available.

Full duplex UART (Baud rate timer, Timer0,1,2,3,4 and A)

- Parity check, Overrun error / Framing error detection
- Transfer size 7 to 8 bits can be selected.

Serial 3 (Full duplex UART / Synchronous serial interface)

Synchronous serial interface

- Transfer clock source
fpll/2, fpll/4, fpll/16, fpll/64, fs/2, fs/4, Timer0,1,2,3,4 and A output ,external clock
- MSB/LSB can be selected as the first bit to be transferred. An arbitrate transfer size from 1 to 8 bits can be selected.

- Sequence transmission, reception or both are available.

Full duplex UART (Baud rate timer, Timer0,1,2,3,4 and A)

- Parity check, Overrun error / Framing error detection
- Transfer size 7 to 8 bits can be selected.

Serial 4 (multi master I2C / Synchronous serial interface)

Synchronous serial interface

- Transfer clock source
fpll/2, fpll/4, fpll/8, fpll/32, fs/2, fs/4, Timer0,1,2,3,4 and A output, external clock
- MSB/LSB can be selected as the first bit to be transferred. An arbitrate transfer size from 1 to 8 bits can be selected.
- Sequence transmission, reception or both are available.

Multi master I2C

- 7-bit of slave address can be set.
- General call communication mode handling

Serial 5

- IIC slave interface
- IIC high-speed transfer mode (communication speed: 400 kbps)
- 7-bit or 10-bit of slave address can be set.
- General call communication mode handling

- LED Driver: 8 pins (Push-pull structure)

- Automatic Reset

- LCD Driver: LCD driver pins

Segment output max. 55 pins (SEG0 to 54)

SEG0 to 54 can be switched to I/O ports by 1 pin

[Note:At reset, SEG0 to 54 are input ports.]

Common output pins:4 pins

COM0 to 3 can be switched to I/O ports by 1 pin

Display mode selection

Static

1/2 duty, 1/2 bias

1/3 duty, 1/3 bias

1/4 duty, 1/3 bias

LCD driver clock

- When the source clock is the main clock (fpll)
 $1/2^{18}, 1/2^{17}, 1/2^{16}, 1/2^{15}, 1/2^{14}, 1/2^{13}, 1/2^{12}, 1/2^{11}$
- When the source clock is the sub clock (fx)
 $1/2^9, 1/2^8, 1/2^7, 1/2^6$
- Timer0, 1, 2, 3, 4 and A output

LCD power supply

Use at $V_{DD5} \geq V_{LC1}$
External supply voltage is input from $V_{LC1}, V_{LC2}, V_{LC3}$ pins or voltage applied to V_{LC1} is divided by internal resistance and supplied to V_{LC2} and V_{LC3} pins.

- DAC for audio reproduction

Analog DAC input
PWM digital output
Continuous reproduction function
Repeat function (phrase repeat)
Volume control (2048 tone)
Sampling frequency: 8 to 44.1 kHz

- Port:

I/O ports	: 85 pins
LED (large current) driver pins	: 8 pins
LCD driver for segment	: 55 pins
LCD driver for common	: 4 pins
serial interface pin	: 34 pins
Timer I/O	: 28 pins
Buzzer output	: 4 pins
A/D input	: 12 pins
External interrupt pin	: 5 pins
LCD power	: 3 pins
XI/XO	: 2 pins
D/A output	: 4 pins
Audio output	: 2 pins

Special pins	: 10 pins
Operation mode input pins	: 3 pin
Analog reference voltage input pins	: 1 pin
Reset input pin	: 1 pin
Oscillation pins	: 2 pins
Power pins	: 6 pins

1.3 Pin Description

1.3.1 Pin configuration

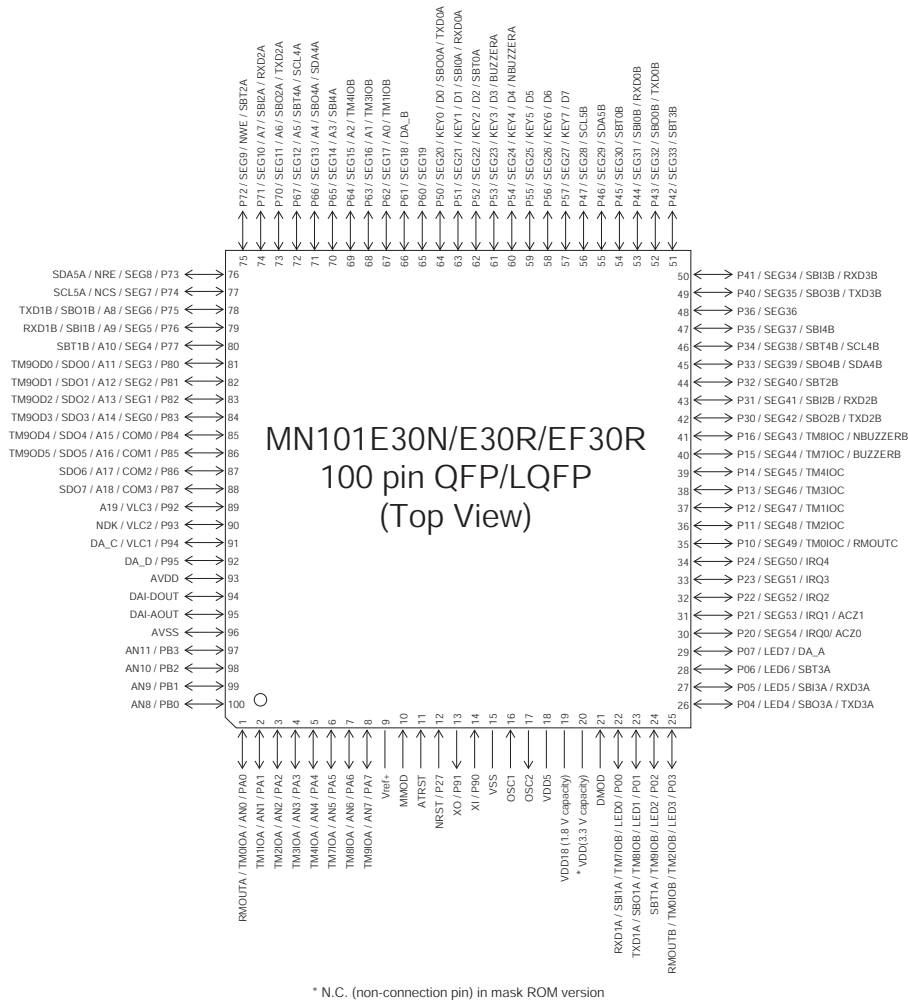


Figure:1.3.1 Pin Configuration (MN101E30N/MN101E30R/MN101EF30R)

Mode	Object microcontroller	Activation area	Pin setting					Register setting	
			NRST	ATRST	DMOD	P01	P02	MMOD	EXMEM flag
Single chip mode	FLASH-ROM MASK-ROM	MAIN	(1)	L or H	H	Normal pin		L	0
Memory extend mode	FLASH-ROM MASK-ROM	MAIN	(1)	L or H	H	Normal pin		L	1
Micro controller rewriting mode (3)	FLASH-ROM	BOOT	(1)	L	H	Normal pin		H	0
D-wire communication mode(3)	FLASH-ROM	-	(2)	L	(2)	Pull up(2)	Pull up(2)	L	0

Mode	Object microcontroller	Activation area	Pin setting						Register setting
			NRST	ATRST	DMOD	P01	P02	MMOD	EXMEM flag

(1)The mode becomes fixed from the pin state in releasing NRST(L to H).

(2)This is controlled by a dedicated on-board programmer

(3)This mode becomes the rewriting mode only for Flash microcontroller.

Therefore does not exist in the Mask version (MN101E30N/E30R)

1.3.2 Pin Specification

Table:1.3.1 Pin Specification

Pins	Special Functions	I/O	Direction Control	Pin Control	Functions Description
P00	RXD1A SBI1A	in/out	P0DIR0	P0PLUD0	RXD1A: UART1 reception data input SBI1A: Serial1 reception data output
P01	TM7IOB LED0 TXD1A SBO1A	in/out	P0DIR1	P0PLUD1	TM7IOB: Timer 7 input / output LED0: LED driver pin 0 TXD1A: UART1 transmission data output SBO1A: Serial1 transmission data output
P02	TM8IOB LED1 SBT1A TM9IOB	in/out	P0DIR2	P0PLUD2	TM8IOB: Timer 8 input / output LED1: LED driving pin 1 SBT1A: Serial 1 clock input / output TM9IOB: Timer 9 input / output
P03	LED2 RMOUTB TM0IOB	in/out	P0DIR3	P0PLUD3	LED2: LED driving pin 2 RMOUTB: Remote control carrier output TM0IOB: Timer 0 input / output
P04	TM2IOB LED3 LED4 SBO3A	in/out	P0DIR4	P0PLUD4	TM2IOB: Timer 2 input / output LED3: LED driving pin 3 LED4: LED driving pin 4 SBO3A: Serial3 transmission data output
P05	TXD3A LED5 SBI3A	in/out	P0DIR5	P0PLUD5	TXD3A: UART3 transmission data output LED5: LED driving pin 5 SBI3A: Serial3 reception data output
P06	RXD3A LED6 SBT3A	in/out	P0DIR6	P0PLUD6	RXD3A: UART3 reception data input LED6: LED driving pin 6 SBT3A: Serial3 clock input / output
P07	LED7 DA_A	in/out	P0DIR7	P0PLUD7	LED7: LED driving pin 7 DA_A: Analog A output
P10	SEG49 TM0IOC RMOUTC	in/out	P1DIR0	P1PLUD0	SEG49: Segment49 output RMOUTC: Remote control carrier output TM0IOC: Timer0 input / output
P11	SEG48 TM2IOC	in/out	P1DIR1	P1PLUD1	SEG48: Segment48 output TM2IOC: Timer2 input / output
P12	SEG47 TM1IOC	in/out	P1DIR2	P1PLUD2	SEG47: Segment47 output TM1IOC: Timer1 input / output
P13	SEG46 TM3IOC	in/out	P1DIR3	P1PLUD3	SEG46: Segment46 output TM3IOC: Timer3 input / output
P14	SEG45 TM4IOC	in/out	P1DIR4	P1PLUD4	SEG45: Segment45 output TM4IOC: Timer4 input / output
P15	SEG44 TM7IOC	in/out	P1DIR5	P1PLUD5	SEG44: Segment44 output TM7IOC: Timer7 input / output
P16	BUZZERB SEG43 TM8IOC NBUZZERB	in/out	P1DIR6	P1PLUD6	BUZZERB: Buzzer output SEG43: Segment43 output NBUZZERB: Buzzer inversion output TM8IOC: Timer8 input / output
P20	SEG54 IRQ0 ACZ0	in/out	P2DIR0	P2PLUD0	SEG54: Segment54 output IRQ0: External interrupt0 ACZ0: Zero-cross detection input
P21	SEG53 IRQ1 ACZ1	in/out	P2DIR1	P2PLUD1	SEG53: Segment53 output IRQ1: External interrupt1 ACZ1: Zero-cross detection input
P22	SEG52 IRQ2	in/out	P2DIR2	P2PLUD2	SEG52: Segment52 output IRQ2: External interrupt2
P23	SEG51 IRQ3	in/out	P2DIR3	P2PLUD3	SEG51: Segment51 output IRQ3: External interrupt3
P24	SEG50 IRQ4	in/out	P2DIR4	P2PLUD4	SEG50: Segment50 output IRQ4: External interrupt4
P27	NRST	in	-	-	NRST: Reset

Pins	Special Functions	I/O	Direction Control	Pin Control	Functions Description	
P30	SEG42 TXD2B	SBO2B	in/out	P3DIR0	P3PLUD0	SEG42: Segment42 output SBO2B: Serial2 transmission data output TXD2B: UART2 transmission data output
P31	SEG41 RXD2B	SBI2B	in/out	P3DIR1	P3PLUD1	SEG41: Segment41 output SBI2B: Serial2 reception data output RXD2B: UART2 reception data input
P32	SEG40	SBT2B	in/out	P3DIR2	P3PLUD2	SEG40: Segment40 output SBT2B: Serial2 clock input / output
P33	SEG39	SBO4B	in/out	P3DIR3	P3PLUD3	SEG39: Segment39 output SBO4B: Serial4 transmission data output
P34	SDA4B SEG38 SCL4B	SBT4B	in/out	P3DIR4	P3PLUD4	SDA4B: IIC4 data input / output SEG38: Segment38 output SCL4B: IIC4 clock input / output SBT4B: Serial4 clock input / output
P35	SEG37	SBI4B	in/out	P3DIR5	P3PLUD5	SEG37: Segment37 output SBI4B: Serial4 reception data output
P36	SEG36		in/out	P3DIR6	P3PLUD6	SEG36: Segment36 output
P40	SEG35 TXD3B	SBO3B	in/out	P4DIR0	P4PLUD0	SEG35: Segment35 output SBO3B: Serial3 transmission data output TXD3B: UART3 transmission data output
P41	SEG34 RXD3B	SBI3B	in/out	P4DIR1	P4PLUD1	SEG34: Segment34 output SBI3B: Serial3 reception data output RXD3B: UART3 reception data input
P42	SEG33	SBT3B	in/out	P4DIR2	P4PLUD2	SEG33: Segment33 output SBT3B: Serial3 clock input / output
P43	SEG32 TXD0B	SBO0B	in/out	P4DIR3	P4PLUD3	SEG32: Segment32 output SBO0B: Serial0 transmission data output TXD0B: UART0 transmission data output
P44	SEG31 RXD0B	SBI0B	in/out	P4DIR4	P4PLUD4	SEG31: Segment31 output SBI0B: Serial0 reception data output RXD0B: UART0 reception data input
P45	SEG30	SBT0B	in/out	P4DIR5	P4PLUD5	SEG30: Segment30 output SBT0B: Serial0 clock input / output
P46	SEG29	SDA5B	in/out	P4DIR6	P4PLUD6	SEG29: Segment29 output SDA5B: IIC5 data input / output
P47	SEG28	SCL5B	in/out	P4DIR7	P4PLUD7	SEG28: Segment28 output SCL5B: IIC5 clock input / output
P50	SEG20 D0	KEY0 SBO0A	in/out	P5DIR0	P5PLUD0	SEG20: Segment20 output D0: Data input / output (bp0) KEY0: KEY interrupt input0 SBO0A: Serial0 transmission data output
P51	TXD0A SEG21 D1	KEY1 SBI0A	in/out	P5DIR1	P5PLUD1	TXD0A: UART0 reception data input SEG21: Segment21 output D1: Data input / output (bp1) KEY1: KEY interrupt input1 SBI0A: Serial0 reception data output
P52	RXD0A SEG22 D2	KEY2 SBT0A	in/out	P5DIR2	P5PLUD2	RXD0A: UART0 transmission data output SEG22: Segment22 output D2: Data input / output (bp2) KEY2: KEY interrupt input2 SBT0A: Serial0 clock input / output
P53	SEG23 D3	KEY3 BUZZE RA	in/out	P5DIR3	P5PLUD3	SEG23: Segment23 output D3: Data input / output (bp3) KEY3: KEY interrupt input3 BUZZERA: Buzzer output
P54	SEG24 D4	KEY4 NBUZZE RA	in/out	P5DIR4	P5PLUD4	SEG24: Segment24 output D4: Data input / output (bp4) KEY4: KEY interrupt input4 NBUZZERA: Buzzer inversion output
P55	SEG25 D5	KEY5	in/out	P5DIR5	P5PLUD5	SEG25: Segment25 output D5: Data input / output (bp5) KEY5: KEY interrupt input5
P56	SEG26 D6	KEY6	in/out	P5DIR6	P5PLUD6	SEG26: Segment26 output D6: Data input / output (bp6) KEY6: KEY interrupt input6
P57	SEG27 D7	KEY7	in/out	P5DIR7	P5PLUD7	SEG27: Segment27 output D7: Data input / output (bp7) KEY7: KEY interrupt input7

Pins	Special Functions	I/O	Direction Control	Pin Control	Functions Description
P60	SEG19		in/out	P6DIR0 P6PLUD0	SEG19: Segment19 output
P61	SEG18 DA_B		in/out	P6DIR1 P6PLUD1	SEG18: Segment18 output DA_B: Analog B output
P62	SEG17 A0 TM1IOB		in/out	P6DIR2 P6PLUD2	SEG17: Segment17 output A0: Address output (bp0) TM1IOB: Timer1 input / output
P63	SEG16 A1 TM3IOB		in/out	P6DIR3 P6PLUD3	SEG16: Segment16 output A1: Address output (bp1) TM3IOB: Timer3 input / output
P64	SEG15 A2 TM4IOB		in/out	P6DIR4 P6PLUD4	SEG15: Segment15 output A2: Address output (bp2) TM4IOB: Timer4 input / output
P65	SEG14 A3 SBI4A		in/out	P6DIR5 P6PLUD5	SEG14: Segment14 output A3: Address output (bp3) SBI4A: Serial4 reception data output
P66	SEG13 A4 SBO4A SDA4A		in/out	P6DIR6 P6PLUD6	SEG13: Segment13 output A4: Address output (bp4) SBO4A: Serial4 transmission data output SDA4A: IIC4 data input / output
P67	SEG12 A5 SBT4A SCL4A		in/out	P6DIR7 P6PLUD7	SEG12: Segment12 output A5: Address output (bp5) SBT4A: Serial4 clockinput / output SCL4A: IIC4 clock input / output
P70	SEG11 A6 SBO2A TXD2A		in/out	P7DIR0 P7PLUD0	SEG11: Segment11 output A6: Address output (bp6) SBO2A: Serial2 transmission data output TXD2A: UART2 transmission data output
P71	SEG10 A7 SBI2A RXD2A		in/out	P7DIR1 P7PLUD1	SEG10: Segment10 output A7: Address output (bp7) SBI2A: Serial2 reception data output RXD2A: UART2 reception data input
P72	SEG9 NWE SBT2A		in/out	P7DIR2 P7PLUD2	SEG9: Segment9 output NWE: Write enable signal SBT2A: Serial2 clock input / output
P73	SDA5A NRE SEG8		in/out	P7DIR3 P7PLUD3	SDA5A: IIC5 data input / output NRE: Read enable signal SEG8: Segment8 output
P74	SCL5A NCS SEG7		in/out	P7DIR4 P7PLUD4	SCL5A: IIC5 clock input / output NCS: Chip selection signal SEG7: Segment7 output
P75	TXD1B SBO1B		in/out	P7DIR5 P7PLUD5	TXD1B: UART1 transmission data output SBO1B: Serial1 transmission data output
P76	A8 SEG6 RXD1B SBI1B		in/out	P7DIR6 P7PLUD6	A8: Address output (bp8) SEG6: Segment6 output RXD1B: UART1 reception data input SBI1B: Serial1 reception data output
P77	A9 SEG5 SBT1B A10 SEG4		in/out	P7DIR7 P7PLUD7	A9: Address output (bp9) SEG5: Segment5 output SBT1B: Serial1 clock input / output A10: Address output (bp10) SEG4: Segment4 output
P80	TM9OD0 SDO0 A11 SEG3		in/out	P8DIR0 P8PLU0	TM9OD0: Timer9 output SDO0: Timer synchronous output0 A11: Address output (bp11) SEG3: Segment3 output
P81	TM9OD1 SDO1 A12 SEG2		in/out	P8DIR1 P8PLU1	TM9OD1: Timer9 output SDO1: Timer synchronous output1 A12: Address output (bp12) SEG2: Segment2 output
P82	TM9OD2 SDO2 A13 SEG1		in/out	P8DIR2 P8PLU2	TM9OD2: Timer9 output SDO2: Timer synchronous output2 A13: Address output (bp13) SEG1: Segment1 output
P83	TM9OD3 SDO3 A14 SEG0		in/out	P8DIR3 P8PLU3	TM9OD3: Timer9 output SDO3: Timer synchronous output3 A14: Address output (bp14) SEG0: Segment0 output
P84	TM9OD4 SDO4 A15 COM0		in/out	P8DIR4 P8PLU4	TM9OD4: Timer9 output SDO4: Timersynchronous soutput4 A15: Address output (bp15) COM0: LCD common output
P85	TM9OD5 SDO5 A16 COM1		in/out	P8DIR5 P8PLU5	TM9OD5: Timer9 output SDO5: Timer synchronous output5 A16: Address output (bp16) COM1:LCD common output
P86	SDO6 A17 COM2		in/out	P8DIR6 P8PLU6	SDO6: Timer synchronous output6 A17: Address output (bp17) COM2:LCD common output
P87	SDO7 A18 COM3		in/out	P8DIR7 P8PLU7	SDO7: Timer synchronous output7 A18: Address output (bp18) COM3:LCD common output

Pins	Special Functions	I/O	Direction Control	Pin Control	Functions Description	
P90	XI	in	P9DIR0	P9PLU0	XI: Clock input pin	
P91	XO	out	P9DIR1	P9PLU1	XO: Clock output pin	
P92	A19	in/out	P9DIR2	P9PLU2	A19: Address output (bp19)	V _{LC3} : LCD power supply
P93	NDK	in/out	P9DIR3	P9PLU3	NDK: Data acknowledge signal	V _{LC2} : LCD power supply
P94	V _{LC1}	in/out	P9DIR4	P9PLU4	V _{LC1} : LCD power supply	DA_C: AnalogC output
P95	DA_D	in/out	P9DIR5	P9PLU5	DA_D: AnalogD output	
PA0	RMOUTA AN0	in/out	PADIR0	PAPLU0	RMOUTA: Remote control carrier output AN0: Analog0 input	TM0IOA: Timer0 input / output
PA1	TM1IOA	in/out	PADIR1	PAPLU1	TM1IOA: Timer1 input / output	AN1: Analog1 input
PA2	TM2IOA	in/out	PADIR2	PAPLU2	TM2IOA: Timer2 input / output	AN2: Analog2 input
PA3	TM3IOA	in/out	PADIR3	PAPLU3	TM3IOA: Timer3 input / output	AN3: Analog3 input
PA4	TM4IOA	in/out	PADIR4	PAPLU4	TM4IOA: Timer4 input / output	AN4: Analog4 input
PA5	TM7IOA	in/out	PADIR5	PAPLU5	TM7IOA: Timer7 input / output	AN5: Analog5 input
PA6	TM8IOA	in/out	PADIR6	PAPLU6	TM8IOA: Timer8 input / output	AN6: Analog6 input
PA7	TM9IOA	in/out	PADIR7	PAPLU7	TM9IOA: Timer9 input / output	AN7: Analog7 input
PB0	AN8	in/out	PBDIR0	PBPLU0	AN8: Analog8 input	
PB1	AN9	in/out	PBDIR1	PBPLU1	AN9: Analog9 input	
PB2	AN10	in/out	PBDIR2	PBPLU2	AN10: Analog10 input	
PB3	AN11	in/out	PBDIR3	PBPLU3	AN11: Analog11 input	
DA1_ DOUT	DA1_DOUT	out	-	-	Audio digital output	
DA1_ AOUT	DA1_AOUT	out	-	-	Audio analog output	

1.3.3 Pin Functions

Table:1.3.2 Pin Functions

Name	NO	I/O	Other Function	Function	Description
V _{SS} V _{DD5} AV _{DD} AV _{SS}	15 18 93 96	-		Power connect pins	Supply 2.2 V to 5.5 V to V _{DD5} , 5.0 V to AV _{DD} and 0 V to V _{SS} and AV _{SS} .
V _{DD18} (Capacity 1.8 V)	19	-		Capacity connect pins	For internal power circuit output stability, connect at least one bypass capacitor of 1 uF or larger between V _{DD18} and V _{SS} .
V _{DD} (Capacity 3.3 V)	20	-		Capacity connect pins	For internal power circuit output stability, connect at least one bypass capacitor of 1 uF or larger between V _{DD} and V _{SS} . (Only Flash version)
OSC1 OSC2	16 17	Input Output		Clock input pins Clock output pins	Connect these oscillation pins to ceramic or crystal oscillators for high-frequency clock operation. If the clock is an external input, connect it to OSC1 and leave OSC2 open. The chip will not operate with an external clock when using either the STOP or SLOW modes.
XI XO	14 13	Input Output	P90 P91	Clock input pins Clock output pins	Connect these oscillation pins to crystal oscillators for low-frequency clock operation. If the clock is an external input, connect it to XI and leave XO open. the chip will not operate with an external clock when using the STOP mode. If these pins are not used, connect XI to V _{SS} and leave XO open.
NRST	12	Input	P27	Reset pin [Active low]	This pin resets the chip when power is turned on, is allocated as P27 and contains an internal pull-up resistor (Type. 50 kΩ). Setting this pin low initialize the internal state of the device. Thereafter, setting the input to high releases the reset. The hardware waits for the system clock to stabilize, then processes the reset interrupt. Also, if "0" is written to P27 and the reset is initiated by software, a low level will be output. The output has an n-channel open-drain configuration. If a capacitor is to be inserted between NRST and V _{SS} , it is recommended that a discharge diode be placed between NRST and V _{DD5} .
ATRST	11	input		Auto reset setting pins 2	Input "H" to enable auto reset function and "L" to disable this function
P00 P01 P02 P03 P04 P05 P06 P07	22 23 24 25 26 27 28 29	I/O	RXD1A,SBI1A, TM7IOB, LED0 TXD1A,SBO1A, TM8IOB, LED1 SBT1A, TM9IOB, LED2 RMOUTB, TM0IOB, TM2IOB, LED3 LED4,SBO3A, TXD3A LED5,SBI3A, RXD3A LED6, SBT3A LED7, DA_A	I/O port0	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P0DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P0PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. (However, pull-up and pull-down resistors cannot be mixed.) Direct LED drive available at output. At reset, the input mode is selected and pull-up resistors are disabled (high impedance).

Name	NO	I/O	Other Function	Function	Description
P10	35	I/O	SEG49, TM0IOC, RMOUTC	I/O port1	7-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P1DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P1PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. A pull-up/pull down can not be mixed. At reset, the input mode is selected and pull-up resistors are disabled (high impedance).
P11	36		SEG48, TM2IOC		
P12	37		SEG47, TM1IOC		
P13	38		SEG46, TM3IOC		
P14	39		SEG45, TM4IOC		
P15	40		SEG44, TM7IOC, BUZZERB		
P16	41		SEG43, TM8IOC, NBUZZERB		
P20	30	I/O	SEG54, IRQ0, ACZ0	I/O port2	5-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P2DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P2PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. (A pull-up/pull down can not be mixed.) At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P21	31		SEG53, IRQ1, ACZ1		
P22	32		SEG52, IRQ2		
P23	33		SEG51, IRQ3		
P24	34		SEG50, IRQ4		
P27	12	input	NRST	I/O port2	Port P27 has an N-channel open-drain configuration. When "0" is written and the reset is initiated by software, a low level will be output.
P30	42	I/O	SEG42, SBO2B, TXD2B	I/O port3	7-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P3DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P3PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. (A pull-up/pull down can not be mixed.) At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P31	43		SEG41, SBI2B, RXD2B		
P32	44		SEG40, SBT2B		
P33	45		SEG39, SBO4B, SDA4B		
P34	46		SEG38, SBT4B, SCL4B		
P35	47		SEG37, SBI4B		
P36	48		SEG36		
P40	49	I/O	SEG35, SBO3B, TXD3B	I/O port4	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P4DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P4PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. A pull-up/pull down can not be mixed. At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P41	50		SEG34, SBI3B, RXD3B		
P42	51		SEG33, SBT3B		
P43	52		SEG32, SBO0B, TXD0B		
P44	53		SEG31, SBI0B, RXD0B		
P45	54		SEG30, SBT0B		
P46	55		SEG29, SDA5B		
P47	56		SEG28, SCL5B		
P50	64	I/O	SEG20, KEY0, D0, SBO0A, TXD0A	I/O port5	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P5DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P5PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. (A pull-up/pull down can not be mixed.) At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P51	63		SEG21, KEY1, D1, SBI0A, RXD0A		
P52	62		SEG22, KEY2, D2, SBT0A		
P53	61		SEG23, KEY3, D3, BUZZERA		
P54	60		SEG24, KEY4, D4, NBUZZERA		
P55	59		SEG25, KEY5, D5		
P56	58		SEG26, KEY6, D6		
P57	57		SEG27, KEY7, D7		
P60	65	I/O	SEG19	I/O port6	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P6DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P6PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. (A pull-up/pull down can not be mixed.) At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P61	66		SEG18, DA_B		
P62	67		SEG17, A0, TM1IOB		
P63	68		SEG16, A1, TM3IOB		
P64	69		SEG15, A2, TM4IOB		
P65	70		SEG14, A3, SBI4A		
P66	71		SEG13, A4, SBO4A, SDA4A		
P67	72		SEG12, A5, SBT4A, SCL4A		

Name	NO	I/O	Other Function	Function	Description
P70	73	I/O	SEG11,A6,SBO2A,TXD2A	I/O port7	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P7DIR register. A pull-up /pull-down resistor for each bit can be selected individually by the P7PLUD register. A pull-up/down resistor connection for each port can be selected individually by the SELUD register. (A pull-up/pull down can not be mixed.) At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P71	74		SEG10,A7,SBI2A,RXD2A		
P72	75		SEG9,NWE,SBT2A		
P73	76		SEG8,SDA5A,NRE		
P74	77		SEG7,SCL5A,NCS		
P75	78		SEG6,TXD1B,SBO1B,A8		
P76	79		SEG5,RXD1B,SBI1B,A9		
P77	80		SEG4,SBT1B,A10		
P80	81	I/O	TM9OD0,SDO0,A11,SEG3	I/O port8	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P8DIR register. A pull-up resistor for each bit can be selected individually by the P8PLUD register. At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P81	82		TM9OD1,SDO1,A12,SEG2		
P82	83		TM9OD2,SDO2,A13,SEG1		
P83	84		TM9OD3,SDO3,A14,SEG0		
P84	85		TM9OD4,SDO4,A15,COM0		
P85	86		TM9OD5,SDO5,A16,COM1		
P86	87		SDO6,A17,COM2		
P87	88		SDO7,A18,COM3		
P90	14	I/O	XI	I/O port9	7-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the P9DIR register. A pull-up resistor for each bit can be selected individually by the P8PLUD register. At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
P91	13		XO		
P92	89		A19,V _{LC3}		
P93	90		NDK,V _{LC2}		
P94	91		DA_C,V _{LC1}		
P95	92		DA_D		
PA0	1	I/O	RMOUTA, TM0IOA, AN0	I/O portA	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the PADIR register. A pull-up resistor for each bit can be selected individually by the PAPLUD register. At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
PA1	2		TM1IOA, AN1		
PA2	3		TM2IOA, AN2		
PA3	4		TM3IOA, AN3		
PA4	5		TM4IOA, AN4		
PA5	6		TM7IOA, AN5		
PA6	7		TM8IOA, AN6		
PA7	8		TM9IOA, AN7		
PB0	100	I/O	AN8	I/O portB	8-bit CMOS tri-state I/O port. Each bit can be set individually as either an input or output by the PBDIR register. A pull-up resistor for each bit can be selected individually by the PBPLUD register. At reset, the input mode is selected and pull-up resistors are disabled (high impedance)
PB1	99		AN9		
PB2	98		AN10		
PB3	97		AN11		
DA1_DOUT	94	I/O		Audio output pins	Special output pins for audio production function These output "L" at reset.
DA1_AOUT	95				
SBO0A	64	I/O	P50,SEG20,KEY0,D0	Serial interface transmission data output pins	Transmission data output pins for serial interface 0 to 4. The output configuration, either CMOS push-pull or n-channel open-drain can be selected with the P0ODC, P3ODC, P4ODC, P5ODC, P6ODC, P7ODC registers. Pull-up resistor can be selected by the P0PLUD, P3PLUD, P4PLUD, P5PLUD, P6PLUD and P7PLUD registers. Select the output mode at the P0DIR, P3DIR, P4DIR, P5DIR, P6DIR and P7DIR registers and serial data output mode by serial mode register 1 (SC0MD1 to SC4MD1). These can be used as normal I/O pins when the serial interface is not used.
SBO0B	52		P43,SEG32,TXD0B		
SBO1A	23		TXD1A, TM8IOB, LED1, P01		
SBO1B	78		TXD1B, A8, SEG6, P75		
SBO2A	73		P70, SEG11, A6, TXD2A		
SBO2B	42		P30, SEG42, TXD2B		
SBO3A	26		P04, LED4, TXD3A		
SBO3B	49		P40, SEG35, TXD3B		
SBO4A	71		P66, SEG13, A4, SDA4A		
SBO4B	45		P33, SEG39, SDA4B		

Name	NO	I/O	Other Function	Function	Description
SBI0A	63	input	P51,SEG21,KEY1,D1	Serial interface reception data input pins	Reception data output pins for serial interface 0 to 4. A pull-up resistor can be selected with the P0ODC, P3ODC, P4ODC, P5ODC, P6ODC, P7ODC registers. Select the output mode at the P0DIR, P3DIR, P4DIR, P5DIR, P6DIR and P7DIR registers and serial data output mode by serial mode register 1 (SC0MD1 to SC4MD1). These can be used as normal I/O pins when the serial interface is not used.
SBI0B	53		P44,SEG31,RXD0B		
SBI1A	22		RXD1A, TM7IOB, LED0, P00		
SBI1B	79		RXD1B, A9, SEG5, P76		
SBI2A	74		P71, SEG10, A7, RXD2A		
SBI2B	43		P31, SEG41, RXD2B		
SBI3A	27		P05, LED5, RXD3A		
SBI3B	50		P41, SEG34, RXD3B		
SBI4A	70		P65, SEG14, A3		
SBI4B	47	P35, SEG37			
SBT0A	62	I/O	P52, SEG22, KEY2, D2	Serial interface clock I/O pins	Clock I/O pins for serial interface 0 to 4. The output configuration, either CMOS push-pull or n-channel open-drain can be selected with the P0ODC, P3ODC, P4ODC, P5ODC, P6ODC, P7ODC registers. Pull-up resistor can be selected by the P0PLUD, P3PLUD, P4PLUD, P5PLUD, P6PLUD and P7PLUD registers. Select the clock I/O with the P0DIR, P3DIR, P4DIR, P5DIR, P6DIR and P7DIR registers and serial data output mode by serial mode register 1 (SC0MD1 to SC4MD1) according to the communication. These can be used as normal I/O pins when the serial interface is not used.
SBT0B	54		P45, SEG30		
SBT1A	24		TM9IOB, LED2, P02		
SBT1B	80		A10, SEG4, P77		
SBT2A	75		P72, SEG9, NWE		
SBT2B	44		P32, SEG40		
SBT3A	28		P06, LED6		
SBT3B	51		P42, SEG33		
SBT4A	72		P67, SEG12, A5, SCL4A		
SBT4B	46	P34, SEG38, SCL4B			
TXD0A	64	output	P50, SEG20, KEY0, D0, SBO0A	UART transmission data output pins	In the serial interface0 to 3 in UART mode, this pin is configured as the transmission data output pin. The output configuration, either CMOS push-pull or n-channel open-drain can be selected with the P0ODC, P3ODC, P4ODC, P5ODC, P7ODC registers. Pull-up resistor can be selected by the P0PLUD, P3PLUD, P4PLUD, P5PLUD and P7PLUD registers. Select the output mode at the P0DIR, P3DIR, P4DIR, P5DIR and P7DIR registers and serial data output mode by serial mode register 1 (SC0MD1 to SC3MD1). These can be used as normal I/O pins when the serial interface is not used.
TXD0B	52		P43, SEG32, SBO0B		
TXD1A	23		SBO1A, TM8IOB, LED1, P01		
TXD1B	78		SBO1B, A8, SEG6, P75		
TXD2A	73		P70, SEG11, A6, SBO2A		
TXD2B	42		P30, SEG42, SBO2B		
TXD3A	26		P04, LED4, SBO3A		
TXD3B	49		P40, SEG35, SBO3B		
RXD0A	63	input	P51, SEG21, KEY1, D1, SBI0A	UART reception data input pins	In the serial interface0 to 3 in UART mode, this pin is configured as the reception data output pin. Pull-up resistor can be selected by the P0PLUD, P3PLUD, P4PLUD, P5PLUD and P7PLUD registers. Select the output mode at the P0DIR, P3DIR, P4DIR, P5DIR and P7DIR registers and serial data output mode by serial mode register 1 (SC0MD1 to SC3MD1). These can be used as normal I/O pins when the serial interface is not used.
RXD0B	53		P44, SEG31, SBI0B		
RXD1A	22		SBI1A, TM7IOB, LED0, P00		
RXD1B	79		SBI1B, A9, SEG5, P76		
RXD2A	74		P71, SEG10, A7, SBI2A		
RXD2B	43		P31, SEG41, SBI2B		
RXD3A	27		P05, LED5, SBI3A		
RXD3B	50		P41, SEG34, SBI3B		
SDA4A	71	I/O	P66, SEG13, A4, SBO4A	IIC data I/O pins	In the serial interface4, 5 in IIC mode, this pin is configured as the data input / output pin. For the output configuration, select n-channel open-drain with the P3ODC, P4ODC, P6ODC and P7ODC registers and pull-up resistors by the P3PLUD, P4PLUD, P6PLUD and P7PLUD registers. Select the output mode at the P3DIR, P4DIR, P6DIR and P7DIR registers and serial data input / output mode by serial mode register 1 (SC4MD1, SC5MD1). These can be used as normal I/O pins when the serial interface is not used.
SDA4B	45		P33, SEG39, SBO4B		
SDA5A	76		NRE, SEG8, P73		
SDA5B	55		P46, SEG29		

Name	NO	I/O	Other Function	Function	Description
SCL4A SCL4B SCL5A SCL5B	72 46 77 56	I/O	P67,SEG12,A5,SBT4A P34,SEG38,SBT4B NCS,SEG7,P74 P47,SEG28	IIC clock I/O pins	In the serial interface4, 5 in IIC mode, this pin is configured as the clock input / output pin. For the output configuration, select n-channel open-drain with the P3ODC, P4ODC, P6ODC and P7ODC registers and pull-up resistors by the P3PLUD, P4PLUD, P6PLUD and P7PLUD registers. Select the output mode at the P3DIR, P4DIR, P6DIR and P7DIR registers and serial data input / output mode by serial mode register 1 (SC4MD1, SC5MD1). These can be used as normal I/O pins when the serial interface is not used
TM0IOA TM0IOB TM0IOC TM1IOA TM1IOB TM1IOC TM2IOA TM2IOB TM2IOC TM3IOA TM3IOB TM3IOC TM4IOA TM4IOB TM4IOC	1 25 35 2 67 37 3 25 36 4 68 38 5 69 39	I/O	RMOUTA,AN0,PA0 RMOUTB,TM2IOB,LED3,P03 P10,SEG49,RMOUTC AN1,PA1 P62,SEG17,A0 P12,SEG47 AN2,PA2 RMOUTB,TM0IOB,LED3,P03 P11,SEG48 AN3,PA3 P63,SEG16,A1 P13,SEG46 AN4,PA4 P64,SEG15,A2 P14,SEG45	Timer I/O pins	Event counter clock input pin, timer output and PWM signal output pin for 8-bit timer 0 to 4. To use this pin as event clock input, configure this as input by P0DIR register, P1DIR register, P6DIR register and PADIR register. In the input mode, pull-up resistors can be selected by the P0PLUD register, P1PLUD register, P6PLUD register and PAPLU register. For timer output, PWM signal output, select the special function pin by port 0 output mode register, port 1 output mode register, port 6 output mode register and port A output mode register ((P0OMD, P1OMD, P6OMD and PAOMD), and set to the output mode at P0DIR register, P1DIR register and PADIR register. These can be used as normal I/O pins when the timer I/O is not used.
RMOUTA RMOUTB RMOUTC	1 25 35	I/O	TM0IOA,AN0,PA0 TM0IOB,TM2IOB,LED3,P03 P10,SEG49,TM0IOC	Remote control transmission signal output pins	Output pin for remote control transmission with a carrier signal. For remote control carrier output, select the special function pin by the port 0 output mode register, port 1 output mode register and port A output mode register (P0OMD, P1OMD and PAOMD), and set to the output mode by the P0DIR register, P1DIR register and PADIR register. At the same time, select remote control carrier output by the remote control carrier output register. These can be used as normal I/O pins when the buzzer output is not used.
BUZZERA BUZZERB NBUZZERA NBUZZERB	61 40 60 41	I/O	P53,SEG23,KEY3,D3 P15,SEG44,TM7IOC P54,SEG24,KEY4,D4 P16,SEG43,TM8IOC	Buzzer output	Piezoelectric buzzer driving pin. Buzzer output available to port1, port5. The driving frequency can be selected with the DLYCTR register. To select buzzer output for port1, port5, select the special function pin by the port 1 output mode register and port 5 output mode register (P1OMD and P5OMD), and set to the output mode by the P1DIR register and P5DIR register. At the same time, select buzzer output by the oscillation stabilization wait control register (DLYCTR). These can be used as normal I/O pins when the buzzer output is not used.

Name	NO	I/O	Other Function	Function	Description
TM7IOA	6	I/O	AN5,PA5	Timer I/O pins	Event counter clock input pin, timer output and PWM signal output pin for 16-bit timer7 and 8. To use this pin as event clock input, configure this as input with the PADIR register. In the input mode, pull-up resistors can be selected by P0PLU register, P1PLU register and PAPLU register. For timer output, PWM signal output, select the special function pin by the port 0 output mode register, port 1 output mode register and port A output mode register (P0OMD, P1OMD and PAOMD), and set to the output mode at P0DIR register, P1DIR register and PADIR register. These can be used as normal I/O pins when not used as timer I/O pins.
TM7IOB	22		RXD1A,SB11A,LED0,P00		
TM7IOC	40		P15,SEG44,BUZZERB		
TM8IOA	7		AN6,PA6		
TM8IOB	23		TXD1A,SBO1A,LED1,P01		
TM8IOC	41		P16,SEG43,NBUZZERB		
TM9IOA	8		AN7,PA7		
TM9IOB	24		SBT1A,LED2,P02		
TM9OD0	81	output	SDO0,A11,SEG3,P80	Timer output pins	Timer output and PWM signal output pin for 16-bit timer. To select timer output and PWM signal output, select the special function pin by the P8OMD1 register, and set to the output mode at the P8DIR register. These can be used as normal I/O pins when not used as timer I/O pins.
TM9OD1	82		SDO1,A12,SEG2,P81		
TM9OD2	83		SDO2,A13,SEG1,P82		
TM9OD3	84		SDO3,A14,SEG0,P83		
TM9OD4	85		SDO4,A15,COM0,P84		
TM9OD5	86		SDO5,A16,COM1,P85		
SDO0	81	output	TM9OD0,A11,SEG3,P80	Synchronous output pins	8-bit synchronous output pins. Synchronous output for each bit can be selected individually by the port 8 synchronous output control register (P8SYO). Set to the output mode by the P8DIR register. These pins can be used as a normal I/O pins when not used for synchronous output pin.
SDO1	82		TM9OD1,A12,SEG2,P81		
SDO2	83		TM9OD2,A13,SEG1,P82		
SDO3	84		TM9OD3,A14,SEG0,P83		
SDO4	85		TM9OD4,A15,COM0,P84		
SDO5	86		TM9OD5,A16,COM1,P85		
SDO6	87		A17,COM2,P86		
SDO7	88		A18,COM3,P87		
V _{REF+}	100	-		+ power supply for A/D converter	Reference power supply pins for the A/D converter. Use this under the condition: $2.0\text{ V} \leq V_{\text{REF}+} \leq V_{\text{DD5}}$
AN0	1	input	RMOUTA, TM0IOA, PA0	Analog input pins	Analog input pins for an 16-channel, 10-bit A/D converter. When not used for analog input, these pins can be used as normal input pins.
AN1	2		TM1IOA, PA1		
AN2	3		TM2IOA, PA2		
AN3	4		TM3IOA, PA3		
AN4	5		TM4IOA, PA4		
AN5	6		TM7IOA, PA5		
AN6	7		TM8IOA, PA6		
AN7	8		TM9IOA, PA7		
AN8	100		PB0		
AN9	99		PB1		
AN10	98		PB2		
AN11	97		PB3		
DA_A	29	output	P07,LED7	Analog output pins	Analog output pins for an 4-channel, 8-bit A/D converter. When not used for analog output, these pins can be used as normal I/O pins.
DA_B	66		P61,SEG18		
DA_C	91		V _{LC1} ,P94		
DA_D	92		P95		
IRQ0	30	input	P20,SEG54	External interrupt input pins	External interrupt input pins. The valid edge for IRQ0 to 4 can be selected with the IRQnICR register. IRQ1 has AC zero-cross detection function. IRQ1 can be set at both edges at pin voltage level. When not used for interrupts, these can be used as normal input pins.
IRQ1	31		P21,SEG53,ACZ1		
IRQ2	32		P22,SEG52		
IRQ3	33		P23,SEG51		
IRQ4	34		P24,SEG50		

Name	NO	I/O	Other Function	Function	Description
ACZ1	31	input	P21,SEG53,IRQ1	AC zero-cross detection input pins	AC zero-cross detection input pin. AC zero-cross detection output "H" when input level is mid-level and "L" otherwise. ACZ input signal is connected to P20 input and IRQ0 interrupt circuit or P21 input and IRQ1 interrupt circuit. When not used for AC zero-cross detection, these can be used as normal input pins.
ACZ0	30		P20,SEG54,IRQ0		
KEY0	64	input	P50,SEG20,D0,SBO0A, TXD0A	Key interrupt input pins	Input pins for interrupt based on OR result of pin inputs. These can be set to key input pins by 1-bit with the key interrupt control register (KEYT3_1IMD, KEYT3_2IMD) and by 2-bit with the key interrupt control register (KEYT3_1IMD). When not used for KEY input, these pins can be used as normal I/O pins.
KEY1	63		P51,SEG21,D1,SBI0A, RXD0A		
KEY2	62		P52,SEG22,D2,SBT0A		
KEY3	61		P53,SEG23,D3,BUZZERA		
KEY4	60		P54,SEG24,D4,NBUZZERA		
KEY5	59		P55,SEG25,D5		
KEY6	58		P56,SEG26,D6		
KEY7	57		P57,SEG27,D7		
LED0	22	I/O	RXD1A,SBI1A, TM7IOB,P00	LED drive pins	Large current output pins. When not used for LED output, these pins can be used as normal I/O pins.
LED1	23		TXD1A,SBO1A, TM8IOB,P01		
LED2	24		SBT1A, TM9IOB,P02		
LED3	25		RMOUTB, TM0IOB, TM2IOB, P03		
LED4	26		P04,SBO3A, TXD3A		
LED5	27		P05,SBI3A, RXD3A		
LED6	28		P06,SBT3A		
LED7	29		P07,DA_A		
NWE	75	output	P72,SEG9,SBT2A	Write enable pins [Active low]	Memory control signal used when the memory area is expanded to the external of this LSI. NWE is the strobe signal output for the write operation of the external memory and NRE is the strobe signal output for the read operation of the external memory. NCS is the chip selection signal outputs the external memory at the access. NDK is the acknowledge signal that indicates close of access to the external memory.
NRE	76		SDA5A,SEG8,P73	Read enable pins [Active low]	
NCS	77		SCL5A,SEG7,P74	Chip select pins [Active low]	
NDK	90	input	V _{LC2} ,P93	Data acknowledge pins [Active low]	
A0	67	output	P62,SEG17, TM1IOB	Address pin	A0-A19 is the address signal to the external memory. D0-D7 is the data I/O signal to the external memory.
A1	68		P63,SEG16, TM3IOB		
A2	69		P64,SEG15, TM4IOB		
A3	70		P65,SEG14, SBI4A		
A4	71		P66,SEG13, SBO4A, SDA4A		
A5	72		P67,SEG12, SBT4A, SCL4A		
A6	73		P70,SEG11, SBO2A, TXD2A		
A7	74		P71,SEG10, SBI2A, RXD2A		
A8	78		TXD1B, SBO1B, SEG6, P75		
A9	79		RXD1B, SBI1B, SEG5, P76		
A10	80		SBT1B, SEG4, P77		
A11	81		TM9OD0, SDO0, SEG3, P80		
A12	82		TM9OD1, SDO1, SEG2, P81		
A13	83		TM9OD2, SDO2, SEG1, P82		
A14	84		TM9OD3, SDO3, SEG0, P83		
A15	85		TM9OD4, SDO4, COM0, P84		
A16	86		TM9OD5, SDO5, COM1, P85		
A17	87		SDO6, COM2, P86		
A18	88		SDO7, COM3, P87		
A19	89	V _{LC3} , P92			

(Continue to next page)

Name	NO	I/O	Other Function	Function	Description
D0	64	I/O	P50,SEG20,KEY0,SBO0A, TXD0A	Data pin	(Continued from previous page)
D1	63		P51,SEG21,KEY1,SBI0A, RXD0A		
D2	62		P52,SEG22,KEY2,SBT0A		
D3	61		P53,SEG23,KEY3,BUZZERA		
D4	60		P54,SEG24,KEY4,NBUZZERA		
D5	59		P55,SEG25,KEY5		
D6	58		P56,SEG26,KEY6		
D7	57		P57,SEG27,KEY7		
COM0	85	Output	TM9OD4,SDO4,A15,P84	LCD common output pins	These pins output common signal of required timing for LCD display. Connect to the common pins of LCD display panel. When the LCD functions are not used, these pins can be used as normal I/O port by the setting the LCD output control register LCCTR0.
COM1	86		TM9OD5,SDO5,A16,P85		
COM2	87		SDO6,A17,P86		
COM3	88		SDO7,A18,P87		
V _{LC1}	91	-	SYSCCLK,DA_C,P94	LCD power supply pins	Supply for LCD power. Apply 5.5 $V_{\geq V_{LC1} \geq V_{LC2} \geq V_{LC3} \geq 0$ V. When the internal voltage divider resistor is used, V _{LC1} =V _{DD5} pin is selected as the reference voltage input pin. When LCD is not used, V _{LC1} to V _{LC3} can be used as normal I/O pins with the setting of LCD output control register0 (LCCTR0).
V _{LC2}	90		NDK,P93		
V _{LC3}	89		A19,P92		
SEG0	84	output	TM9OD3,SDO3,A14,P83	LCD segment output pins	These pins output segment signal of required timing for LCD display. Connect to the segment pins of the LCD display panel. When LCD display is turned off, V _{ss} level is output. These pins can be used as normal I/O pins with the setting of LCD output control register LCCTR1 to 7. SEG can exchange segment pins and normal port by each bit.
SEG1	83		TM9OD2,SDO2,A13,P82		
SEG2	82		TM9OD1,SDO1,A12,P81		
SEG3	81		TM9OD0,SDO0,A11,P80		
SEG4	80		SBT1B,A10,P77		
SEG5	79		RXD1B,SBI1B,A9,P76		
SEG6	78		TXD1B,SBO1B,A8,P75		
SEG7	77		SCL5A,NCS,P74		
SEG8	76		SDA5A,NRE,P73		
SEG9	75		P72,NWE,SBT2A		
SEG10	74		P71,A7,SBI2A,RXD2A		
SEG11	73		P70,A6,SBO2A,TXD2A		
SEG12	72		P67,A5,SBT4A,SCL4A		
SEG13	71		P66,A4,SBO4A,SDA4A		
SEG14	70		P65,A3,SBI4A		
SEG15	69		P64,A2,TM4IOB		
SEG16	68		P63,A1,TM3IOB		
SEG17	67		P62,A0,TM1IOB		
SEG18	66		P61,DA_B		
SEG19	65		P60		
SEG20	64		P50,KEY0,D0,SBO0A, TXD0A		
SEG21	63		P51,KEY1,D1,SBI0A, RXD0A		
SEG22	62		P52,KEY2,D2,SBT0A		
SEG23	61		P53,KEY3,D3,BUZZERA		
SEG24	60		P54,KEY4,D4,NBUZZERA		
SEG25	59		P55,KEY5,D5		
SEG26	58		P56,KEY6,D6		
SEG27	57		P57,KEY7,D7		
SEG28	56		P47,SCL5B		
SEG29	55		P46,SDA5B		
SEG30	54		P45,SBT0B		
SEG31	53		P44,SBI0B, RXD0B		

(Continue to next page)

Name	NO	I/O	Other Function	Function	Description
SEG32	52		P43,SBO0B,TXD0B		(Continued from previous page)
SEG33	51		P42,SBT3B		
SEG34	50		P41,SBI3B,RXD3B		
SEG35	49		P40,SBO3B,TXD3B		
SEG36	48		P36		
SEG37	47		P35,SBI4B		
SEG38	46		P34,SBT4B,SCL4B		
SEG39	45		P33,SBO4B,SDA4B		
SEG40	44		P32,SBT2B		
SEG41	43		P31,SBI2B,RXD2B		
SEG42	42		P30,SBO2B,TXD2B		
SEG43	41		P16,TM8IOC,NBUZZERB		
SEG44	40		P15,TM7IOC,BUZZERB		
SEG45	39		P14,TM4IOC		
SEG46	38		P13,TM3IOC		
SEG47	37		P12,TM1IOC		
SEG48	36		P11,TM2IOC		
SEG49	35		P10,TM0IOC,RMOUTC		
SEG50	34		P24,IRQ4		
SEG51	33		P23,IRQ3		
SEG52	32		P22,IRQ2		
SEG53	31		P21,IRQ1,ACZ1		
SEG54	30		P20,IRQ0		
MMOD	10	input		Memory mode switch input pins	Set always to V_{SS} .
DMOD	21	input		Mode switch input pins	Set always to V_{DD5} .

1.4 Block Diagram

1.4.1 Block Diagram

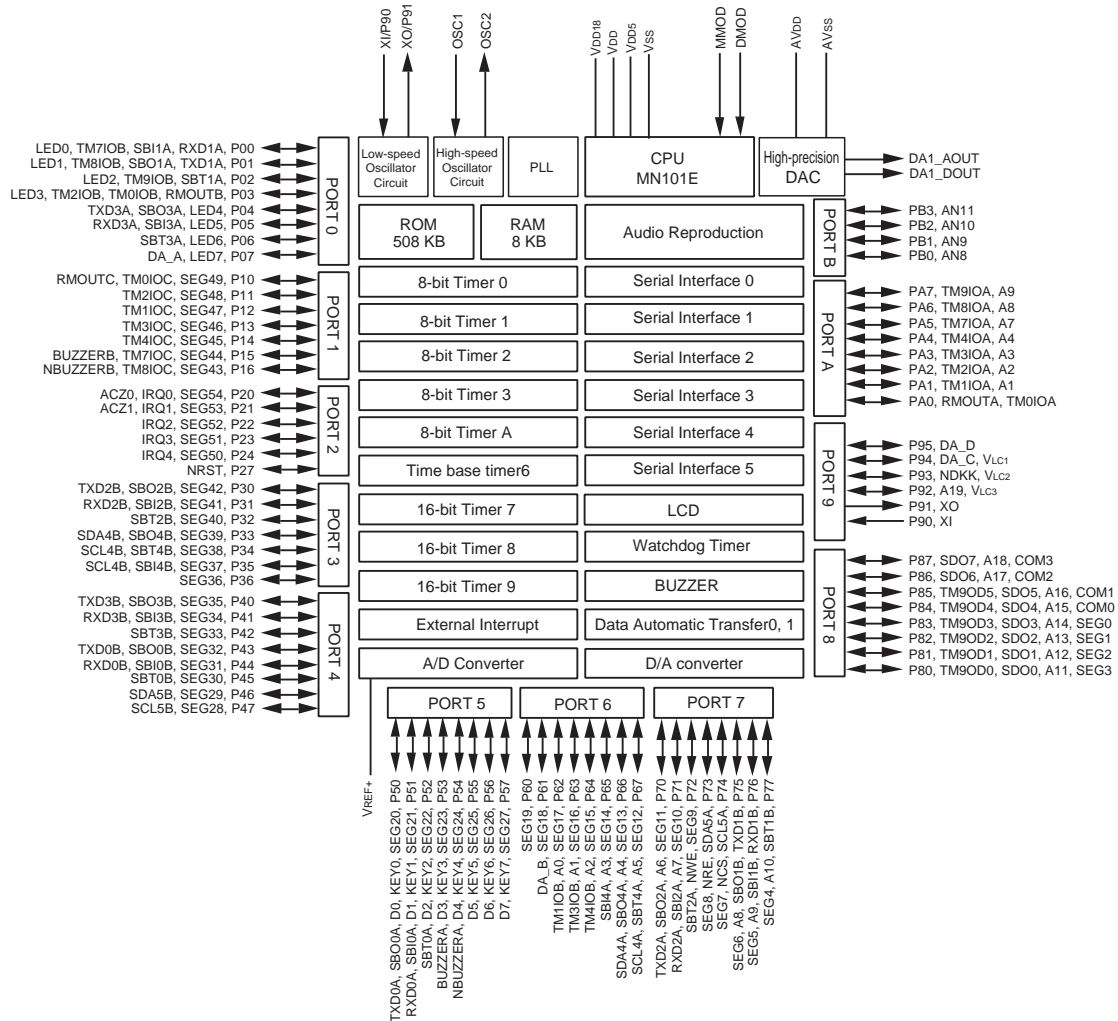


Figure:1.4.1 Block Diagram

* Depending on the models. See [[1.1.2 Product Summary]]

1.5 Electrical Characteristics

This LSI manual describes the standard specification.

Please ask our sales offices for the product specifications.

Model	MN101E30	
Contents	Structure	CMOS integrated circuit
	Application	General purpose
	Function	CMOS, 8-bit, single chip micro controller

1.5.1 Absolute Maximum Ratings *2 *3

$V_{SS} = 0\text{ V}$

Parameter		Symbol	Rating	Unit	
1	Power supply voltage	V_{DD5}	-0.3 to +7.0	V	
2	Capacity connection pin	V_{DD18}	-0.3 to +2.5		
3	*4	V_{DD}	-0.3 to +4.6		
4	Input clamp current (ACZ)	I_C	-500 to +500	μA	
5	Input pin voltage	V_I	-0.3 to $V_{DD5} + 0.3$	V	
6	Output pin voltage	V_O	-0.3 to $V_{DD5} + 0.3$		
7	I/O pin voltage	V_{IO1}	-0.3 to $V_{DD5} + 0.3$		
8	Peak power current	P0	I_{OL1} (peak)	30	mA
9		Other than P0	I_{OL2} (peak)	20	
10		All pins	I_{OH} (peak)	-10	
11	Average output current *1	P0	I_{OL1} (avg)	20	
12		Other than P0	I_{OL2} (avg)	15	
13		All pins	I_{OH} (avg)	-5	
14	Power dissipation	P_T	400	mW	
15	Operating ambient temperature	T_{opr}	-40 to +85	$^{\circ}\text{C}$	
16	Storage temperature	T_{stg}	-55 to +125		

*1 Applied to any 100 ms period.

*2 Connect approximate 1 μF capacitor between V_{DD18}/V_{DD} power supply pin and the ground, and approximate 10-times capacitor connect to V_{DD18}/V_{DD} between V_{DD5} power supply pin and the ground for the internal power supply stabilization.

*3 The absolute maximum ratings are the limit values beyond which the LSI may be damaged.

*4 Applied only in Flash version.

1.5.2 Operating Conditions

$V_{SS} = 0\text{ V}$
 $T_a = -40\text{ °C to }+85\text{ °C}$

Parameter	Symbol	Condition	Rating			Unit		
			MIN	TYP	MAX			
Power supply voltage *4								
1	Power supply voltage	In not using PLL	V_{DD5-1}	$f_{osc} \leq 20\text{ MHz}$ [Double speed mode: $f_s \leq 20\text{ MHz}$]	2.2		5.5	V
2		In using PLL	V_{DD5-2}	$4.0\text{ MHz} \leq f_{osc} \leq 10\text{ MHz}$ [Multiplied by 2 to 10: $f_s \leq 20\text{ MHz}$]	2.2		5.5	
3			V_{DD5-3}	$f_x = 32.768\text{ kHz}$ [Normal mode: $f_s \leq f_x/2$]	2.2		5.5	
4	Voltage to maintain RAM data		V_{DD5-4}	[During STOP mode]	1.8		5.5	
Operating speed *5								
5	Instruction execution time		t_{c1}	$V_{DD5} = 2.2\text{ V to }5.5\text{ V}$	0.05			μs
6			t_{c2}	$V_{DD5} = 2.2\text{ V to }5.5\text{ V}$	61			

*4 f_{osc} : Input clock frequency to OSC1 pin.
 f_x : Input clock frequency to XI pin

*5 t_{c1} : In the case of OSC1 as CPU clock, or OSC1 multiplied by PLL as CPU clock.
 t_{c2} : In the case of XI as CPU clock.



Use LCD power supply voltage with $V_{LC1} \leq V_{DD5}$.

$V_{SS} = 0\text{ V}$
 $T_a = -40\text{ }^\circ\text{C to } +85\text{ }^\circ\text{C}$

Parameter	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
Crystal oscillator 1 Figure:1.5.1 [NORMAL mode]						
7	Crystal frequency	f_{xtal1}	$V_{DD5} = \text{within the operation power supply voltage (Refer to the reference value of power supply voltage 1 to 3.)}$	2.0	20	MHz
8	External capacitors	C_{11}			10	pF
9		C_{12}			10	
10	Internal feedback resistor	R_{f10}	$V_{DD5}=5.0\text{ V}$		950	k Ω
Crystal oscillator 2 Figure:1.5.2 [SLOW mode]						
11	Crystal frequency	f_{xtal2}	$V_{DD5}=2.2\text{ V to } 5.5\text{ V}$		32.768	kHz
12	External capacitors	C_{21}			4	pF
13		C_{22}			4	
14	Internal feedback resistor	R_{f20}	$V_{DD5}=5.0\text{ V}$		6	M Ω

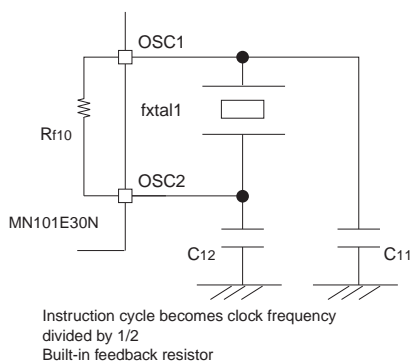


Figure:1.5.1 Crystal oscillator 1

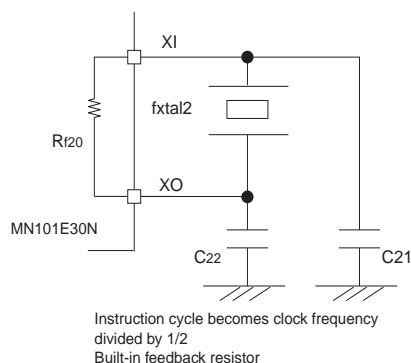


Figure:1.5.2 Crystal oscillator 2



Connect external capacitors that suits the used pin. When crystal oscillator or ceramic oscillator is used, the frequency is changed depending on the condenser rate. Therefore, consult the manufacturer of the pin for the appropriate external capacitor.

$V_{DD5} = 2.2\text{ V to }5.5\text{ V}$ $V_{SS} = 0\text{ V}$
 $T_a = -40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
External clock input 1 OSC1 (OSC2 is unconnected)						
15	Clock frequency	f_{OSC1}	1.0		20.0	MHz
16	High level pulse width *6	t_{wh1}	22.5			ns
17	Low level pulse width *6	t_{wl1}	22.5			
18	Rising time *7	t_{wr1}	0		5.0	
19	Falling time *7	t_{wf1}	0		5.0	
External clock input 2 XI (XO is unconnected)						
20	Clock frequency	f_{OSC2}		32.768		kHz
21	High level pulse width *6	t_{wh2}		4.5		μs
22	Low level pulse width *6	t_{wl2}		4.5		
23	Rising time *7	t_{wr2}	0		20	ns
24	Falling time *7	t_{wf2}	0		20	

*6 The clock duty rate in the standard mode should be 45 % to 55 %

*7 Rising time and falling time differ depending on oscillation frequency.

This is noted that the maximum value is a rough value, not a specified value.

Consult the oscillator manufacturer and perform matching tests for determining appropriate values.

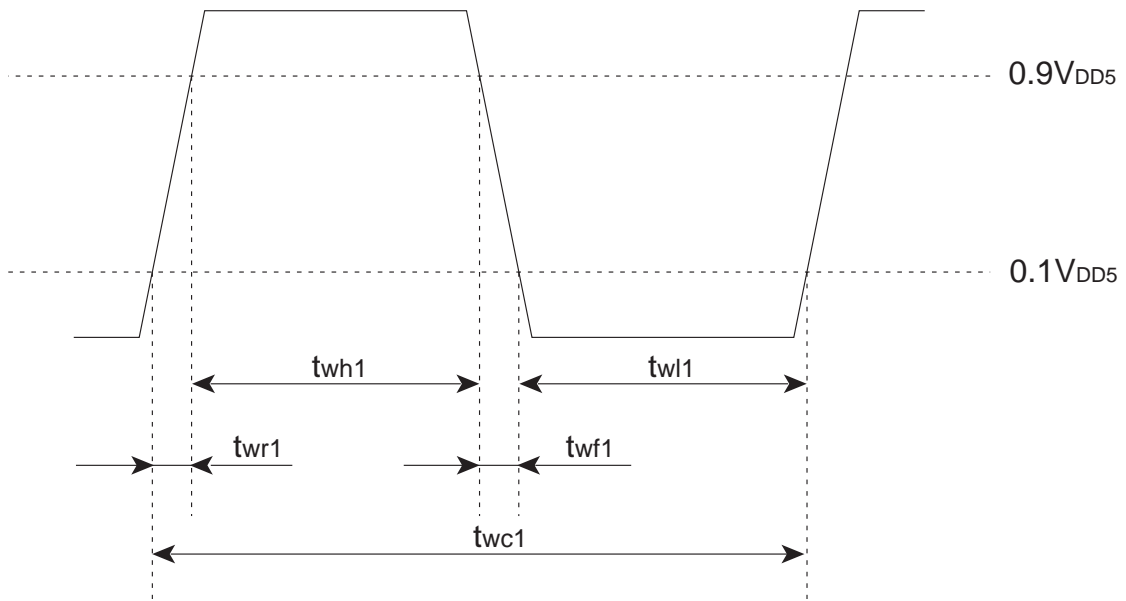


Figure:1.5.3 OSC1 Timing Chart

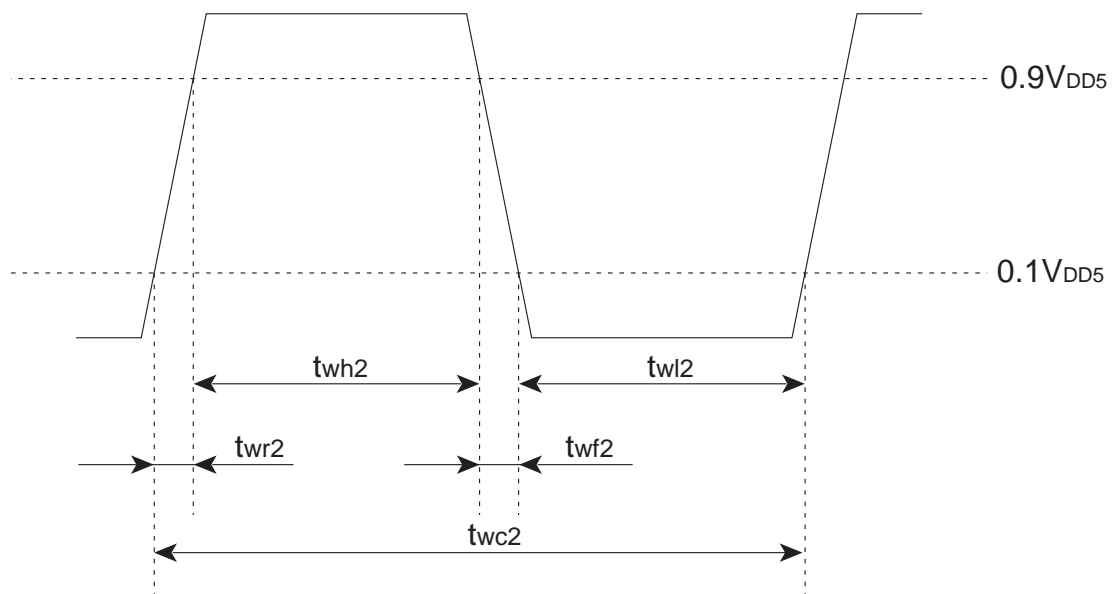


Figure:1.5.4 XI Timing Chart

1.5.3 DC Characteristics

$V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit		
			MIN	TYP	MAX			
Power supply current *8 (NORMAL mode: $f_s=f_{osc}/2$ SLOW mode: $f_s=f_x/2$)								
1	I_{DD1}	$f_{osc}=20\text{ MHz}$ [Double-speed mode: $f_s=f_{osc}$] $V_{DD5}=5\text{ V}$ (In not using PLL)		4 (9)	8 (18)	mA		
2			I_{DD2}	$f_{osc}=4\text{ MHz}$ [Multiplied by 5: $f_s=20\text{ MHz}$] $V_{DD5}=5\text{ V}$ (In using PLL)			4 (10)	8 (20)
3					I_{DD}		$f_{osc}=8\text{ MHz}$ [Double-speed mode: $f_s=f_{osc}$] $V_{DD5}=5\text{ V}$ (In not using PLL)	
4			I_{DD4}	$f_{osc}=4\text{ MHz}$ [Double-speed mode: $f_s=f_{osc}$] $V_{DD5}=5\text{ V}$ (In not using PLL)				
5					I_{DD5}	$f_x=32.768\text{ MHz}$, [$f_s=f_x/2$] $V_{DD5}=3\text{ V}$ $T_a=25\text{ }^\circ\text{C}$		5 (60)
6	I_{DD6}	$f_x=32.768\text{ MHz}$, [$f_s=f_x/2$] $V_{DD5}=3\text{ V}$ $T_a=85\text{ }^\circ\text{C}$					75 (200)	
7			Supply current during HALT1 mode	I_{DD7}	$f_x=32.768\text{ MHz}$ $V_{DD5}=3\text{ V}$ $T_a=25\text{ }^\circ\text{C}$		4 (6)	13 (18)
8	I_{DD8}	$f_x=32.768\text{ kHz}$ $V_{DD5}=3\text{ V}$ $T_a=85\text{ }^\circ\text{C}$						70 (80)
9			Supply current during STOP mode	I_{DD9}	$V_{DD5}=5\text{ V}$ $T_a=25\text{ }^\circ\text{C}$		1 (2)	6 (7)
10	I_{DD10}	$V_{DD5}=5\text{ V}$ $T_a=85\text{ }^\circ\text{C}$						60 (60)

*8 Measured under condition without load. (pull-up / pull-down resistors are unconnected.)

- The supply current during operation, I_{DD1} to I_{DD4} are measured under the following conditions:
After all I/O pins are set to input mode and the oscillation is set to <NORMAL mode>, the MMOD pin is at V_{SS} level, the input pins are at V_{DD5} level, and a 20 MHz square wave of V_{DD5} and V_{SS} amplitudes is input to the OSC1 pin.
- The supply current during operation, I_{DD5} and I_{DD6} are measured under the following conditions:
After all I/O pins are set to input mode and the oscillation is set to <SLOW mode>, the MMOD pin is at V_{SS} level, the input pins are at V_{DD5} level, and a 32.768 kHz square wave of V_{DD5} and V_{SS} amplitudes is input to the XI pin.
- The supply current during HALT1 mode, I_{DD7} and I_{DD8} are measured under the following conditions:
After all I/O pins are set to input mode and the oscillation is set to <HALT1 mode>, the input pins are at V_{DD5} level, and an 32.768 kHz square wave of V_{DD5} and V_{SS} amplitudes is input to the XI pin.
- The supply current during STOP mode, I_{DD9} and I_{DD10} are measured under the following conditions:
After the oscillation is set to <STOP mode>, the MMOD pin is at V_{SS} level, the input pins are at V_{DD5} level, and the OSC1 and XI pins are unconnected.
- The values in parentheses are for Flash version.

$V_{DD5}=2.2\text{ V to }5.5\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit
			MIN	TYP	MAX	
Input pin 1 MMOD, DMOD, ATRST						
11	Input high voltage	V_{IH1}	$0.8V_{DD5}$		V_{DD}	V
12	Input low voltage	V_{IL1}	0		$0.2V_{DD5}$	
13	Input leakage current	I_{LK1}	$V_{IN}=0\text{ V to }V_{DD5}$		± 2	μA
I/O pin 2 P27 (NRST)						
14	Input high voltage	V_{IH2}	$0.8V_{DD5}$		V_{DD5}	V
15	Input low voltage	V_{IL2}	0		$0.15V_{DD5}$	
16	Pull-up resistor	R_{RH1}	$V_{DD5}=5.0\text{ V}$ $V_{IN}=V_{SS}$ Pull-up resistor ON		10 50 100	$\text{k}\Omega$
I/O pin 3 P10 to P16, P20 to P24, P30 to P36, P40 to P47, P50 to P57, P60 to P67, P70 to P77						
17	Input high voltage	V_{IH3}	$0.8V_{DD5}$		V_{DD5}	V
18	Input low voltage	V_{IL3}	0		$0.2V_{DD5}$	
19	Input leakage current	I_{LK2}	$V_{IN}=0\text{ V to }V_{DD5}$		± 2	μA
20	Pull-up resistor	R_{RH2}	$V_{DD5}=5.0\text{ V}$ $V_{IN}=V_{SS}$ Pull-up resistor ON		10 50 100	$\text{k}\Omega$
21	Pull-down resistor	R_{RH1}	$V_{DD5}=5.0\text{ V}$ $V_{IN}=V_{SS}$ Pull-down resistor ON		10 50 100	
22	Output high voltage	V_{OH1}	$V_{DD5}=5.0\text{ V}$ $I_{OH}=-0.5\text{ mA}$		4.5	V
23	Output low voltage	V_{OL1}	$V_{DD5}=5.0\text{ V}$ $I_{OL}=1.0\text{ mA}$		0.5	

$V_{DD5}=2.2\text{ V to }5.5\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit
			MIN	TYP	MAX	
I/O pin 4 P80 to P87, P90 to P95, PA0 to PA7, PB0 to PB3						
24	Input high voltage	V_{IH4}	$0.8V_{DD5}$		V_{DD5}	V
25	Input low voltage	V_{IL4}	0		$0.2V_{DD5}$	
26	Input leak current	I_{LK3}	$V_{IN}=0\text{ V to }V_{DD5}$		± 2	μA
27	Pull-up resistor	R_{RH3}	$V_{DD5}=5.0\text{ V}$ $V_{IN}=V_{SS}$ Pull-up resistor ON		10 50 100	$\text{k}\Omega$
28	Output high voltage	V_{OH2}	$V_{DD5}=5.0\text{ V}$ $I_{OH}=0.5\text{ mA}$		4.5	V
29	Output low voltage	V_{OL2}	$V_{DD5}=5.0\text{ V}$ $I_{OL}=1.0\text{ mA}$		0.5	
I/O pin 5 P00 to P07						
30	Input high voltage1	V_{IH5}	$0.8V_{DD5}$		V_{DD5}	V
31	Input low voltage1	V_{IL5}	0		$0.2V_{DD5}$	
32	Input leak current	I_{LK4}	$V_{IN}=0\text{ V to }V_{DD5}$		± 2	μA
33	Pull-up resistor	R_{RH4}	$V_{DD5}=5.0\text{ V}$ $V_{IN}=V_{SS}$ Pull-up resistor ON		10 50 100	$\text{k}\Omega$
34	Pull-down resistor	R_{RL2}	$V_{DD5}=5.0\text{ V}$ $V_{IN}=V_{SS}$ Pull-down resistor ON		10 50 100	
35	Output high voltage	V_{OH3}	$V_{DD5}=5.0\text{ V}$ $I_{OH}=0.5\text{ mA}$		4.5	V
36	Output low voltage1	V_{OL3}	$V_{DD5}=5.0\text{ V}$ $I_{OL}=1.0\text{ mA}$ LED output OFF		0.5	
37	Output low voltage2	V_{OL4}	$V_{DD5}=5.0\text{ V}$ $I_{OL}=15\text{ mA}$ LED output ON		1.0	

$V_{DD5}=2.2\text{ V to }5.5\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit	
			MIN	TYP	MAX		
I/O pin 6 P20 (during used as ACZ) and P21 (during used as ACZ) are regulated at 5.0 V							
38	Input high voltage1	V_{DHH}	Figure:1.5.5	4.5		V	
39	Input high voltage2	V_{DHL}		1.5			
40	Input low voltage1	V_{DLH}			3.5		
41	Input low voltage2	V_{DLL}			0.5		
42	Input clamp current	I_{C3}	$V_{IN} > V_{DD5}, V_{IN} < 0\text{ V}$			± 500	μA
Display output pin 1 COM0 to COM3 (At V_{LC1}, V_{SS} Voltage output) *9							
43	Output high voltage (In V_{LC1} voltage output)	V_{OCOMH}	$V_{DD5}=V_{LC1}=5.0\text{ V}$ $I_{COM}=-10\text{ }\mu\text{A}$	4.4		V	
44	Output low voltage (In V_{SS} voltage output)	V_{OCOML}	$V_{DD5}=V_{LC1}=5.0\text{ V}$ $I_{COM}=10\text{ }\mu\text{A}$		0.6		
Display output pin 2 SEG0 to SEG54 (At V_{LC1}, V_{SS} Voltage output) *10							
45	Output high voltage (In V_{LC1} voltage output)	V_{OSEGH}	$V_{DD5}=V_{LC1}=5.0\text{ V}$ $I_{SEG}=-2\text{ }\mu\text{A}$	4.4		V	
46	Output low voltage (In V_{SS} voltage output)	V_{OSEGL}	$V_{DD5}=V_{LC1}=5.0\text{ V}$ $I_{SEG}=2\text{ }\mu\text{A}$		0.6		
Display power pin 1 $V_{LC1}, V_{LC2}, V_{LC3}$							
47	Internal dividing resistor	R_{VL1}	$T_a=+25\text{ }^\circ\text{C}$ *11 (Impedance between V_{LC1} and V_{SS})	142.5	300	570	$\text{k}\Omega$
48		R_{VL2}		15	30	60	

*9 However, COM0 to COM3 are also used as P84 to P87.

*10 However, SEG0 to SEG54 are also used as P10 to P16, P20 to P24, P30 to P36, P40 to P47, P50 to P57, P60 to P67, P70 to P77 and P80 to 83.

*11 Summation of 3 resistors among V_{LC1} and V_{LC2} , V_{LC2} and V_{LC3} , V_{LC3} and V_{SS}

1.5.4 A/C Converter Characteristics

$V_{DD5}=5.0\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit
			MIN	TYP	MAX	
ACZ1 pin						
1	Rising time	t_{rs}	30			μs
2	Falling time	t_{fs}				

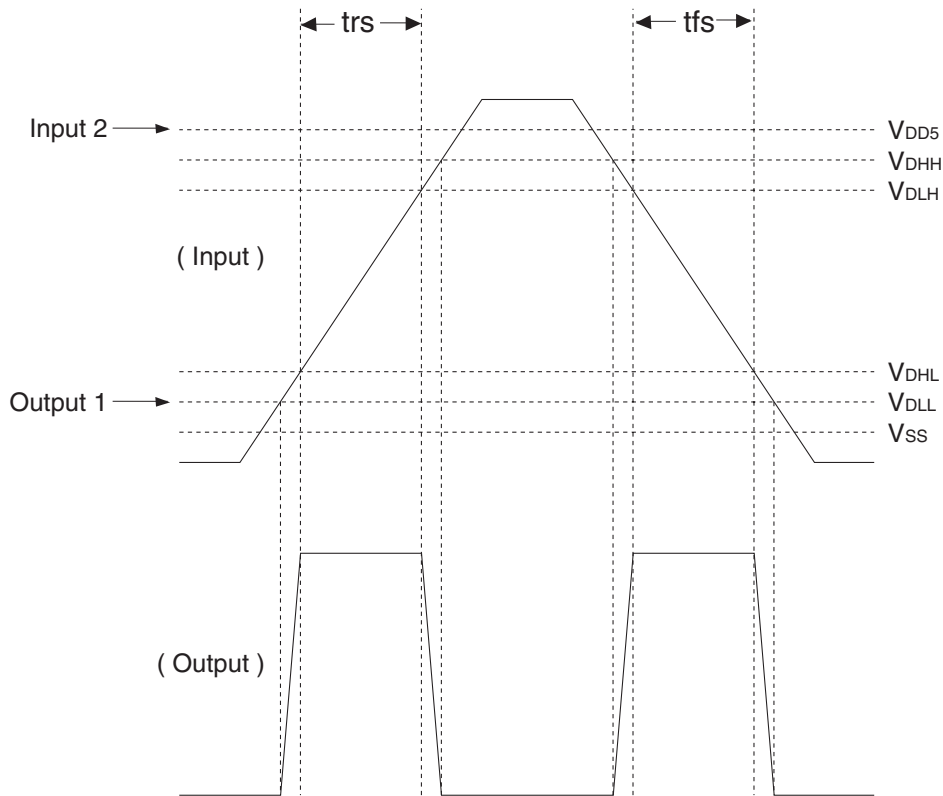


Figure:1.5.5 Operation of AC Zero-Cross Detection Circuit

1.5.5 A/D Converter Characteristics

$V_{DD5}=5.0\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit
			MIN	TYP	MAX	
1	Resolution				10	Bits
2	Non-linearity error 1	$V_{DD5}=5.0\text{ V}$, $V_{SS}=0\text{ V}$ $V_{ref+}=5.0\text{ V}$			± 3	LSB
3	Differential linearity error 1	$T_{AD}=800\text{ ns}$ *12			± 3	
4	Zero transition voltage	$V_{DD5}=5.0\text{ V}$, $V_{SS}=0\text{ V}$ $V_{ref+}=5.0\text{ V}$	-30	10	30	mV
5	Full-scale transition voltage	$T_{AD}=800\text{ ns}$ *12	4970	4990	5030	
6	A/D conversion time	$T_{AD}=800\text{ ns}$ *12	12.93			μs
7		$f_x=32.768\text{ kHz}$ $T_{AD}=15.2\text{ }\mu\text{s}$ *12	427.25			
8	Sampling time	$T_{AD}=800\text{ ns}$ *12	1.6			
9		$f_x=32.768\text{ kHz}$ $T_{AD}=15.2\text{ }\mu\text{s}$ *12	30.52			
10	Reference voltage	V_{ref+} (Note)	2.0		V_{DD5}	V
11	Analog input voltage		V_{SS}		V_{ref+}	
12	Analog input leakage current	When channel is OFF $V_{ADIN}=0\text{ V to }5.0\text{ V}$			± 2	μA
13	Reference voltage pin input leakage current	When V_{REF+} is OFF $V_{SS} \leq V_{REF+} \leq V_{DD5}$			± 5	
14	Ladder resistance	R_{LADD} $V_{DD5}=5.0\text{ V}$	15	40	80	k Ω

*12 T_{AD} is A/D conversion clock cycle.

The values of 2 to 5 are guaranteed on the condition that $V_{DD5}=V_{ref+}=5\text{ V}$, $V_{SS}=0\text{ V}$.

Note) The voltage difference between V_{REF+} and V_{SS} should be set to more than 2 V.



The reference voltage input to V_{REF+} pin should be used on the condition of $2.0\text{ V} \leq V_{REF+} \leq V_{DD5}$ to avoid the malfunctions of microcomputer.

1.5.6 D/A Converter Characteristics

$V_{DD5}=5.0\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=25\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit
			MIN	TYP	MAX	
1	Resolution		-	-	8	Bits
2	Reference voltage low level	D_{AVSS}	V_{SS}	-		V
3	Reference voltage high level	D_{AVDD}		-	V_{DD5}	
4	Zero scale output voltage	V_{ZS} $V_{DD5}=5.0\text{ V}$, $V_{SS}=0\text{ V}$ D7 to D0=ALL "L"	-0.05	0	0.05	
5	Full scale output voltage	V_{FS} $V_{DD5}=5.0\text{ V}$, $V_{SS}=0\text{ V}$ D7 to D0=ALL "H"	4.93	4.98	5.03	
6	Analog output resistance (Minimum reference resistance)	R_{OAT}	5	10	15	k Ω
7	Non-linearity error	N_{LE} $V_{DD5}=5.0\text{ V}$, $V_{SS}=0\text{ V}$	-	± 2.0	± 3.0	LSB
8	Differential non-linearity error	D_{NLE} $V_{DD5}=5.0\text{ V}$, $V_{SS}=0\text{ V}$	-	± 2.0	± 3.0	
9	Settling time	T_{SET} External capacitor $C_L=15\text{ pF}$ All bits are set to ON or OFF	-	1.5	3.0	μs

1.5.7 Auto Reset Characteristics

$V_{DD5}=V_{RST}$ to 5.5 V $V_{SS}=0$ V
Ta=-40 °C to +85 °C

Parameter	Symbol	Conditions	Rating			Unit	
			MIN	TYP	MAX		
Power supply voltage							
1	Operation voltage	V_{DD7}	Auto reset is used	V_{RST}		5.5	V
Power supply voltage							
2	Power supply detection level	V_{RST}		3.7		4.5	V
3	Supply voltage change rate	$\Delta t/\Delta V$		250			$\mu\text{s/V}$
Power supply current							
4	Auto reset power consumption	I_{DD7}	$V_{DD5}=5$ V		220	330	μA

1.5.8 Audio Output Characteristics

$V_{DD5}=AV_{DD}=5.5\text{ V}$ $V_{SS}=0\text{ V}$
 $T_a=-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating			Unit	
			MIN	TYP	MAX		
Output pin 7 DA1_AOUT							
1	Power supply voltage	AV_{DD}	$AV_{DD}=V_{DD5}$	4.5		5.5	V
2	Signal-to-noise ratio	S/N	$AV_{DD}=5\text{ V}$ (Note1)	80	88		dB
3	Dynamic range	D.R.	$AV_{DD}=5\text{ V}$ (Note1)	70	78		dB
4	Total harmonic distortion ratio	THD+N	$AV_{DD}=5\text{ V}$ (Note1)		0.16	0.26	%
5	Output impedance	R_{AOUT}	$AV_{DD}=5\text{ V}$	0.25		2.0	k Ω
Output pin 8 DA1_DOUT							
6	Output voltage high level	V_{OH2}	$V_{DD5}=5.0\text{ V}$ $I_{OH}=-2\text{ mA}$	4.5			V
7	Output voltage low level	V_{OL2}	$V_{DD5}=5.0\text{ V}$ $I_{OL}=2.0\text{ mA}$			0.5	

(Note1) This is the value sampling 1kHz SIN wave at 20kHz and recording with 16bit-PCM.

(Note2) H2,H3 and H4 are the output level at the measuring point on the audio characteristic measuring circuit(Figure:1.5.6).

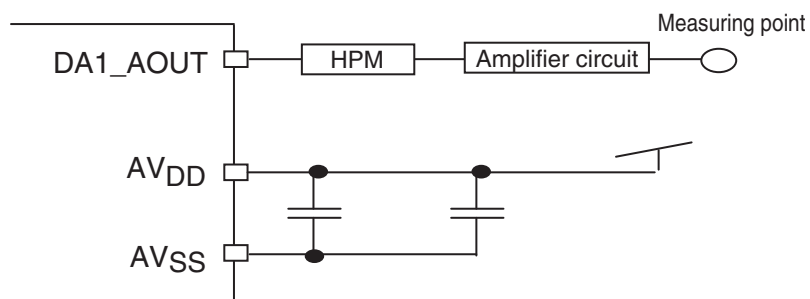


Figure:1.5.6 Audio Characteristic Measuring Circuit (a)



AV_{DD} and V_{DD5} should be at the same electric potential regardless of whether or not the audio production function is used.

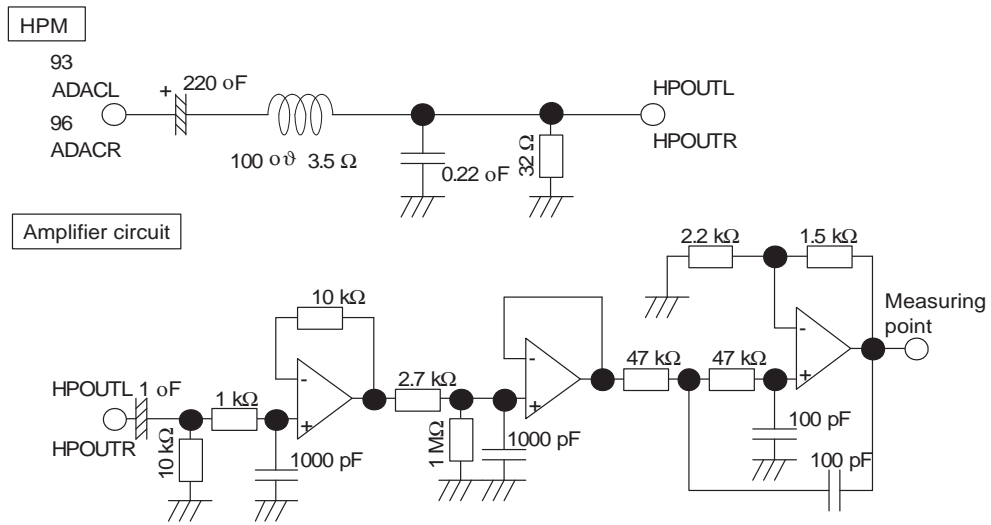


Figure:1.5.7 Audio Characteristic Measuring Circuit (b)

1.5.9 Flash EEPROM Program Condition

	Item	Symbol	Condition	Rating			Unit
				MIN	TYP	MAX	
1	Programming voltage level	V_{DD5-6}		2.7		5.5	V
2	Data retention period	T _{hold}		10			Years
3	Programming guarantee number times	E_{MAX}				1000	Times

1.6 Package Dimension

Units: mm

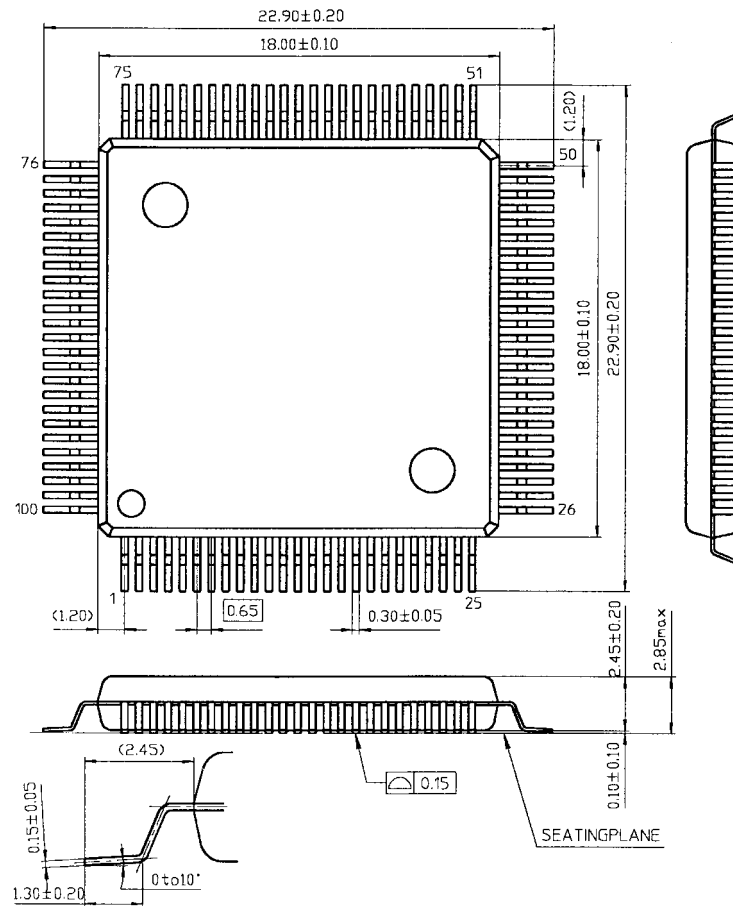


Figure:1.6.1 Package Dimension (QFP100-P-1818B)

Sealing material:	EPOXY resin
Lead material :	Cu alloy
Lead surface processing :	Pd plating



The external dimensions of the package are subject to change. Before using this product, please obtain product specifications from the sales offices.

Units: mm

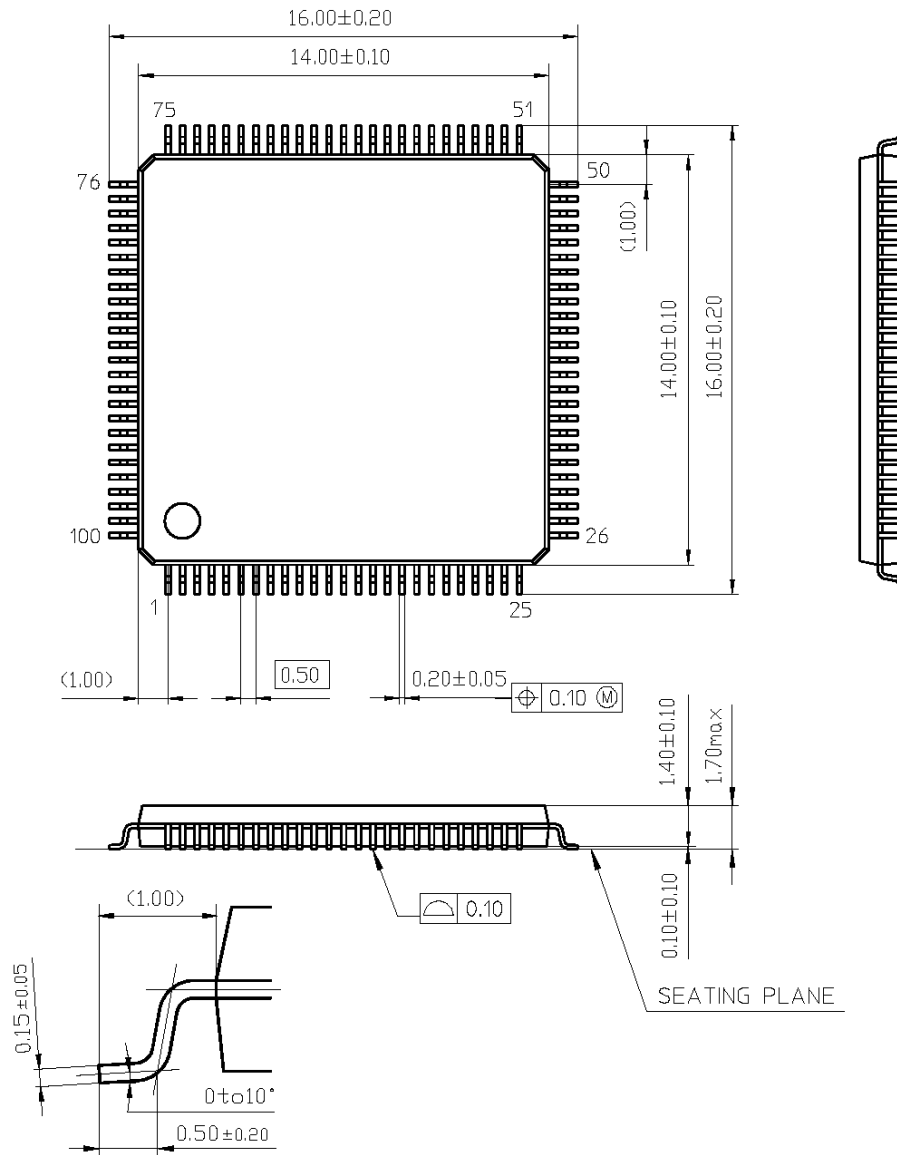


Figure:1.6.2 Package Dimension (LQFP100)



The external dimensions of the package are subject to change. Before using this product, please obtain product specifications from the sales offices.

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