

# W541L260 Data Sheet



## 4-BIT MICROCONTROLLER

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## 1. GENERAL DESCRIPTION

W541L260 is fully compatible with W741L260 in the terms of pin assignment and IC function except main oscillator. It is a high-performance 4-bit microcontroller ( $\mu\text{C}$ ) with an LCD driver. The device contains a 4-bit ALU, two 8-bit timers, two dividers, a  $32 \times 4$  LCD driver, and five 4-bit I/O ports (including 1 output port to drive the LEDs). There are also five interrupt sources and 8-level subroutine nesting for interrupt applications. The W541L260 has one power reduction mode to help minimize power dissipation.

The W541L260 has two oscillator circuits and can work in dual-clock or single-clock operation mode. It is suitable for remote controllers, watches and clocks, speech synthesis LSI controllers, and other products.

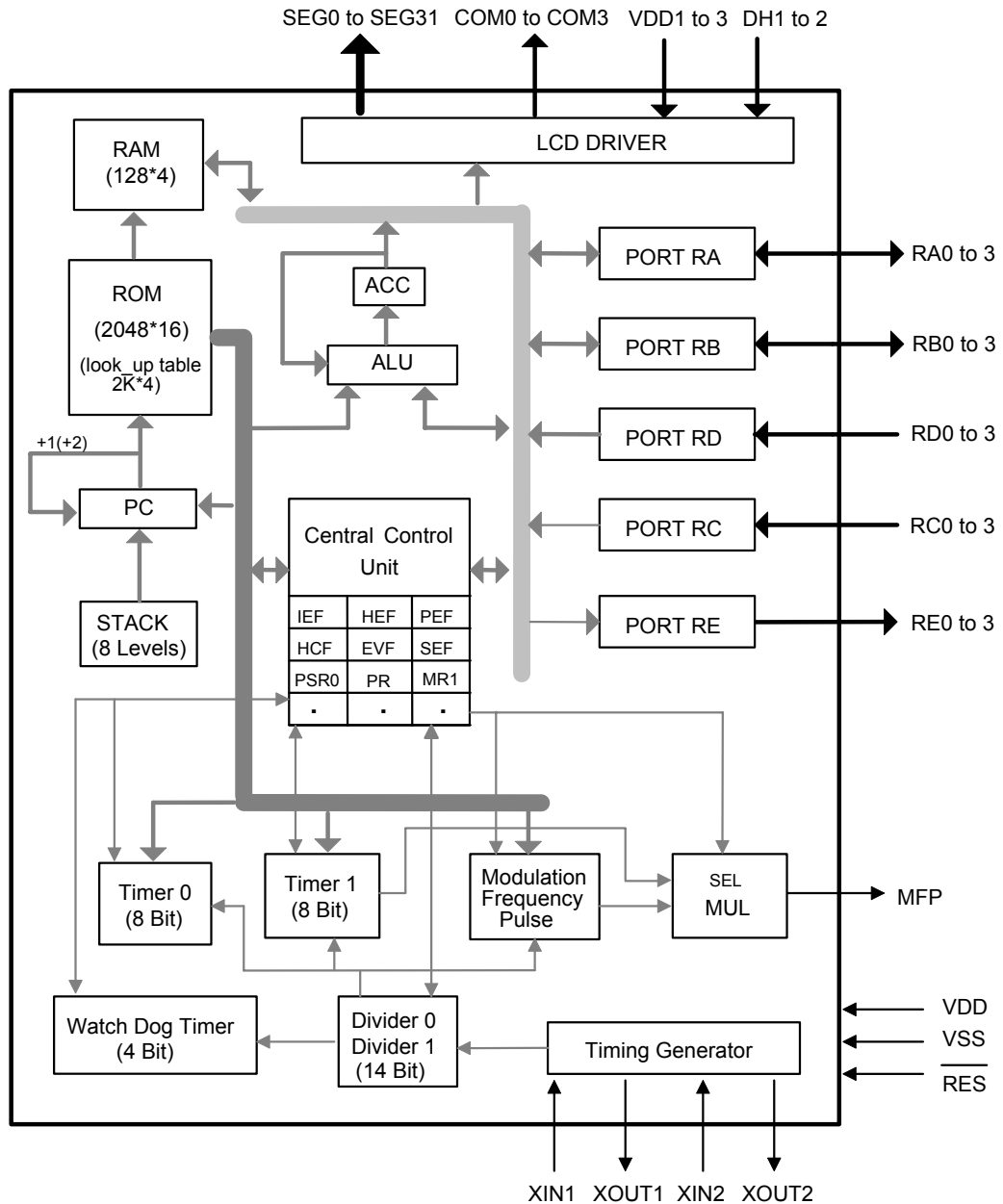
## 2. FEATURES

- Operating voltage: 1.2V–1.8V (LCD drive voltage: 3.0V, or 4.5V)
- Single or Dual Clock Mode
  - Single (main oscillator only) or dual clock (both main and sub-oscillator) by mask option .
  - Sub-oscillator is only 32.768 KHz crystal for dual clock mode.
  - Main oscillator is crystal or RC oscillation by mask code option .
  - Main clock : High-frequency clock (400 KHz to 1 MHz) or low-frequency clock (32.768 KHz) is selected by mask code option
- Memory
  - $2048 \times 16$  bit program ROM (including  $2\text{K} \times 4$  bit look-up table)
  - $128 \times 4$  bit data RAM (including 16 working registers)
  - $32 \times 4$  LCD data RAM
- 21 input/output pins
  - Ports for input only: 2 ports/8 pins
  - Input/output ports: 2 ports/8 pins
  - Port for output only: 1 port /4 pins (high sink current to drive LEDs)
  - MFP output pin: 1 pin (MFP)
  - Do not be floating when it is as input or output open-drain (NMOS type).
- Power-down mode
  - Hold function: no operation (except for oscillator)
  - Stop function: no operation (including main clock)



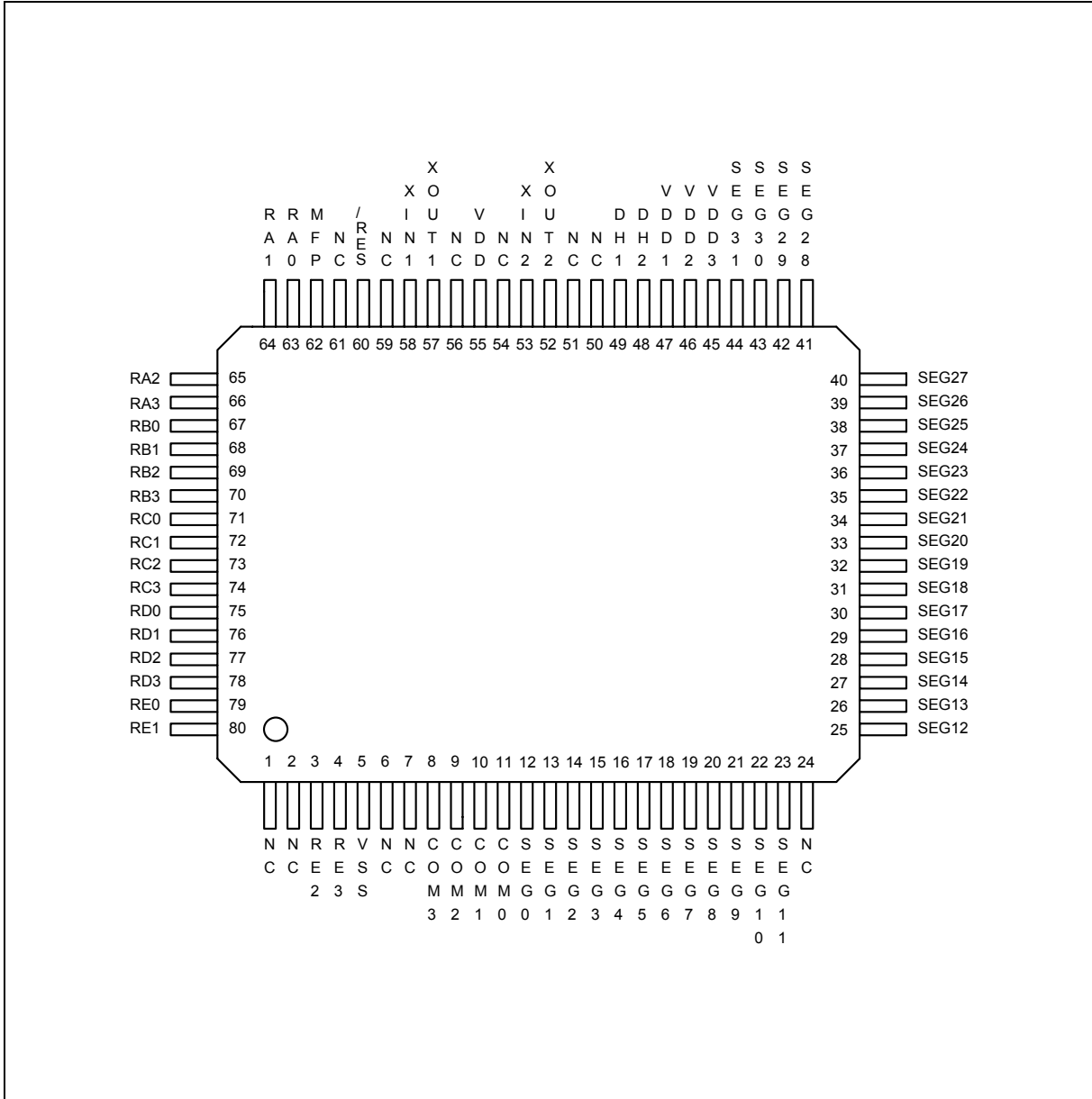
- Five types of interrupts
  - Four internal interrupts (Divider 0, Divider 1, Timer 0, Timer 1)
  - One external interrupt (Port RC)
- LCD driver output
  - 32 segment × 4 common
  - Static, 1/2 duty (1/2 bias), 1/3 duty (1/2 or 1/3 bias), 1/4 duty (1/3 bias) driving mode can be selected
  - LCD driver output pins can be used as DC output ports; selectable by code option
- MFP output pin
  - Output is software selectable as modulating or nonmodulating frequency
  - Works as frequency output specified by Timer 1
- Two built-in 14-bit clock frequency divider circuit (divider 0 and divider 1)
- Two built-in 8-bit programmable countdown timers
  - Timer 0: one of two internal clock frequencies ( $F_{osc}/4$  or  $F_{osc}/1024$ ) can be selected
  - Timer 1: includes an auto-reload function; and one of two internal clock frequencies ( $F_{osc}$  or  $F_{osc}/64$ ) can be selected or falling edge of pin RC.0 can be selected (output through MFP pin)
- Built-in 18/14-bit watchdog timer selectable for system reset
- Powerful instruction set: 115 instructions
- 8-level subroutine (include interrupt) nesting
- Up to 4  $\mu$ S instruction cycle (with 1 MHz operating frequency)
- Packaged in 80-pin QFP

### 3. BLOCK DIAGRAM





4. PIN CONFIGURATION



## 5. PIN DESCRIPTION

SYMBOL	I/O	FUNCTION																									
XIN1	I	Input pin for oscillator. Connected to crystal or resistor to generate system clock by code option. External 10~20pF capacitor uses to get accurate freq in crystal mode.																									
XOUT1	O	Output pin for oscillator. Connected to crystal or resistor to generate system clock by code option. 20pF capacitor is built in internal for crystal mode.																									
XIN2	I	Input pin for sub-oscillator. Connected to a 32.768 KHz crystal. External 10~20pF capacitor uses to get accurate freq in crystal mode.																									
XOUT2	O	Output pin for sub-oscillator. Connected to a 32.768 KHz crystal. 20pF capacitor is built in internal for crystal mode.																									
RA0~RA3	I/O	Input/Output port. Input/output mode specified by port mode 1 register (PM1).																									
RB0~RB3	I/O	Input/Output port. Input/output mode specified by port mode 2 register (PM2).																									
RC0~RC3	I	4-bit port for input only. Each pin has an independent interrupt capability. And build-in schmitt trigger.																									
RD0~RD3	I	4-bit port for input only.																									
RE0~RE3	O	Output port only. This port provides high sink current to drive LEDs.																									
MFP	O	Output pin only. This pin can output modulating or nonmodulating frequency, or Timer 1 clock output specified by mode register 1 (MR1).																									
$\overline{\text{RES}}$	I	System reset pin with pull-high resistor.																									
SEG0~SEG31	O	LCD segment output pins. Can also be used as DC output ports specified by code option.																									
COM0~COM3	O	LCD common signal output pins. <table border="1" data-bbox="526 1423 1117 1633"> <thead> <tr> <th></th> <th>Static</th> <th>1/2 Duty</th> <th>1/3 Duty</th> <th>1/4 Duty</th> </tr> </thead> <tbody> <tr> <td>COM0</td> <td>Used</td> <td>Used</td> <td>Used</td> <td>Used</td> </tr> <tr> <td>COM1</td> <td>Not Used</td> <td>Used</td> <td>Used</td> <td>Used</td> </tr> <tr> <td>COM2</td> <td>Not Used</td> <td>Not Used</td> <td>Used</td> <td>Used</td> </tr> <tr> <td>COM3</td> <td>Not Used</td> <td>Not Used</td> <td>Not Used</td> <td>Used</td> </tr> </tbody> </table> <p>The LCD alternating frequency can be selected by code option.</p>		Static	1/2 Duty	1/3 Duty	1/4 Duty	COM0	Used	Used	Used	Used	COM1	Not Used	Used	Used	Used	COM2	Not Used	Not Used	Used	Used	COM3	Not Used	Not Used	Not Used	Used
	Static	1/2 Duty	1/3 Duty	1/4 Duty																							
COM0	Used	Used	Used	Used																							
COM1	Not Used	Used	Used	Used																							
COM2	Not Used	Not Used	Used	Used																							
COM3	Not Used	Not Used	Not Used	Used																							
DH1, DH2	I	Connection terminals for voltage doubler (halver) capacitor.																									
VDD1, VDD2 VDD3	I	Positive (+) supply voltage terminal. Refer to Functional Description.																									
VDD	I	Positive power supply (+).																									
VSS	I	Negative power supply (-).																									



## 6. ELECTRICAL CHARACTERISTICS

### 6.1 Absolute Maximum Ratings

PARAMETER	RATING	UNIT
Supply Voltage to Ground Potential	-0.3 to +7.0	V
Applied Input/Output Voltage	-0.3 to +7.0	V
Power Dissipation	120	mW
Ambient Operating Temperature	0 to +70	°C
Storage Temperature	-55 to +150	°C

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

### 6.2 DC Characteristics

(V<sub>DD</sub>-V<sub>SS</sub> = 1.5V, F<sub>osc</sub> = 32.768 KHz, T<sub>A</sub> = 25° C; unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Op. Volt ( Crystal type)	VDD1	High-frequency Oscillation	1.35	-	1.8	V
Op. Volt ( RC type)	VDD2	High-frequency Oscillation	1.2	-	1.8	V
Op. Volt ( RC, Crystal)	VDD3	Low-frequency Oscillation	1.2	-	1.8	V
Op. Current (RC Type)	IOP2	No load (Ext-V) In dual-clock normal operation	-	100	400	μA
Op. Current (Crystal Type)	IOP3	No load (Ext-V) In dual-clock slow operation and Fm is stopped	-	8.5	20	μA
Hold Current (RC Type)	IHM2	Hold mode No load (Ext-V) In dual-clock normal operation	-	60	100	μA
Hold Current (Crystal Type)	IHM3	Hold mode No load (Ext-V) In dual-clock slow operation and Fm is stopped	-	4.0	6	μA
Stop Current (Crystal type)	ISM1	Stop mode No load (Ext-V) In dual-clock normal operation	-	4.0	6	μA
Stop Current (Crystal type)	ISM2	Stop mode No load (Ext-V) In single-clock operation	-	0.1	2	μA



DC Characteristics, continue

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input Low Voltage	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.3 V <sub>DD</sub>	V
Input High Voltage	V <sub>IH</sub>	-	0.7 V <sub>DD</sub>	-	V <sub>DD</sub>	V
MFP Output Low Voltage	V <sub>ML</sub>	I <sub>OL</sub> = 0.9 mA	-	0.1	0.3	V
MFP Output High Voltage	V <sub>MH</sub>	I <sub>OH</sub> = 0.75 mA	1.2	1.4	-	V
Port RA, RB Output Low Voltage	V <sub>ABL</sub>	I <sub>OL</sub> = 1.0 mA	-	0.2	0.3	V
Port RA, RB Output High Voltage	V <sub>ABH</sub>	I <sub>OH</sub> = 0.5 mA	1.2	1.4	-	V
LCD Supply Current	I <sub>LCD</sub>	All Seg. ON	-	-	6	μA
SEG0–SEG31 Sink Current (Used as LCD Output)	I <sub>OL1</sub>	V <sub>OL</sub> = 0.05V V <sub>LCD</sub> = 0.0V	6	12	-	μA
SEG0–SEG31 Drive Current (Used as LCD Output)	I <sub>OH1</sub>	V <sub>OH</sub> = 4.45V V <sub>LCD</sub> = 4.5V	1.5	12	-	μA
Segment Output Low Voltage (Used as DC Output)	V <sub>SL</sub>	I <sub>OL</sub> = 150 μA	-	0.1	0.15	V
Segment Output High Voltage (Used as DC Output)	*V <sub>SH</sub>	I <sub>OH</sub> = 1 μA	1.05	1.4	-	V
Port RE Sink Current	I <sub>EL</sub>	V <sub>OL</sub> = 0.3V	2	-	-	mA
Port RE Source Current	I <sub>EH</sub>	V <sub>OH</sub> = 1.2V	0.35	0.45	-	mA
Input Port Pull-up Resistor	R <sub>CD</sub>	Port RC, RD	200	1000	1500	KΩ
$\overline{\text{RES}}$ Pull-up Resistor	R <sub>RES</sub>	-	200	500	1500	KΩ

Note : \*V<sub>SH</sub>: Its ability is based on LCD power connected to 0.1 uF capacitor.

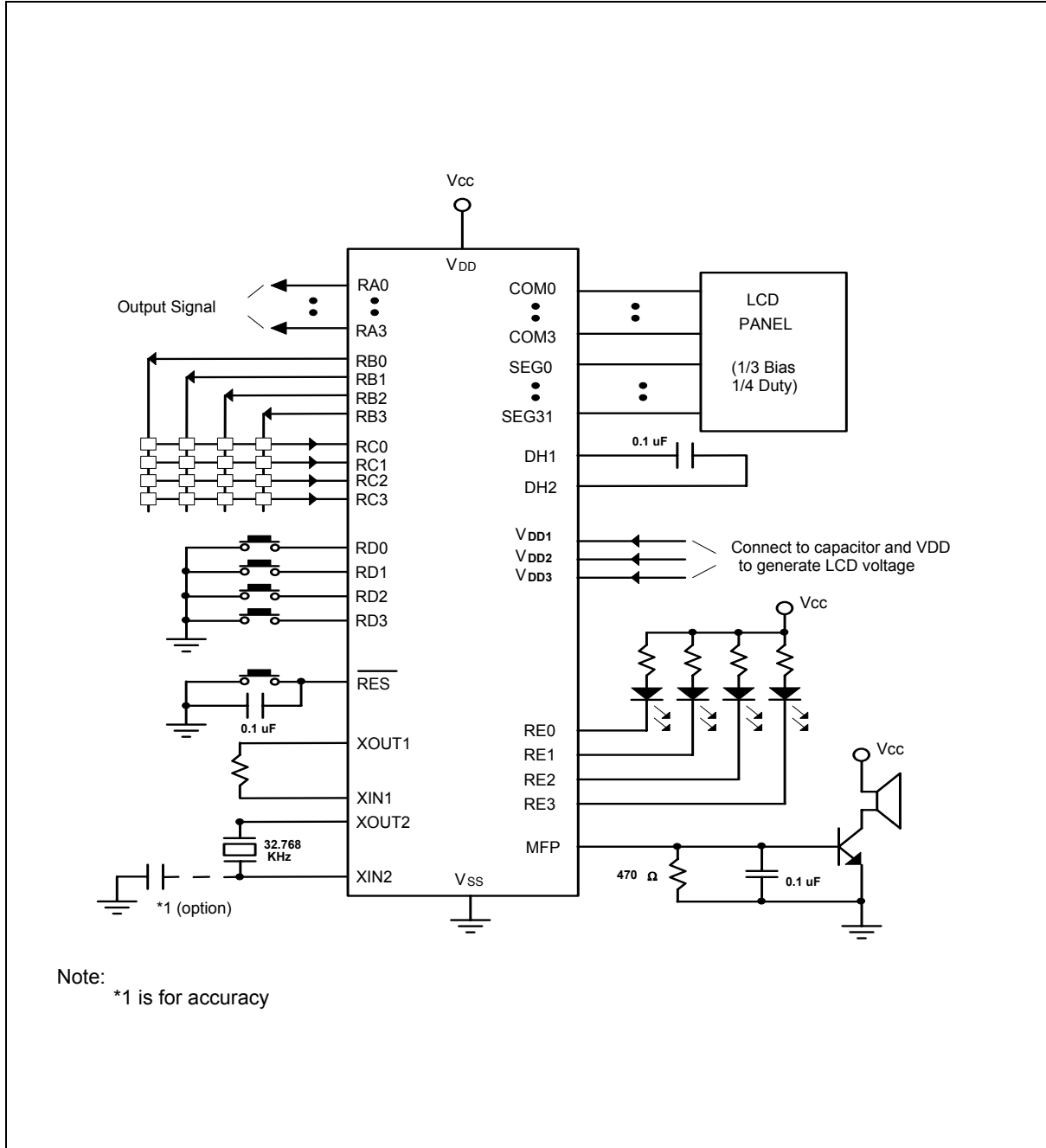


### 6.3 AC Characteristics

(V<sub>DD</sub>-V<sub>SS</sub> = 1.5V, T<sub>A</sub> = 25° C, unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Op. Frequency	FOSC	RC type	-	-	1000	KHz
		Crystal type (Option low speed type only)	-	32.768	-	
Frequency Deviation by Voltage Drop for RC Oscillator	$\frac{\Delta f}{f}$	$\frac{f(1.5V) - f(1.2V)}{f(1.5V)}$	-	-	10	%
Oscillator Start-up Time	T <sub>S</sub>	V <sub>DD</sub> =1.2 V, FOSC=32.768 KHz	-	1	2	S
Instruction Cycle Time	T <sub>I</sub>	One machine cycle	-	4/FOSC	-	mS
Reset Active Width	T <sub>RAW</sub>	FOSC = 32.768 KHz	1	-	-	μS
Interrupt Active Width	T <sub>IAW</sub>	FOSC = 32.768 KHz	1	-	-	μS

## 7. APPLICATION CIRCUIT





## 8. REVISION HISTORY

VERSION	DATE	DESCRIPTION
A2	-	Note: Recommend working voltage range for Hi freq X al mode (L series)
A3	-	Note: RC is built-in schmitt trigger
A4	May 29, 2003	Note: Do not be floating when it is as input or output open-drain (NMOS type)



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