

Preliminary W541C232 Data Sheet



4-BIT MICROCONTROLLER

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1. GENERAL DESCRIPTION

The W541C232 is high-performance 4-bit microcontroller (μC) that provides an LCD driver. The device contains a 4-bit ALU, two 8-bit timer, two dividers, a 16×4 LCD driver, and three 4-bit I/O ports. There are also three interrupt sources and 8-level subroutine nesting for interrupt applications. The W541C232 has two power reduction modes, hold mode and stop mode, which help to minimize power dissipation.

The W541C232 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, hand-held games and other products.

2. FEATURES

- Operating voltage: 2.4V to 5.5V (LCD drive voltage: 3.0V, or 4.5V)
- Dual Clock Operation
 - Sub-oscillator is 32.768K crystal for dual clock mode by mask option.
 - Main oscillator is built-in 4M/ 2MHz/ 1MHz/ 512KHz/ 256KHz RC oscillation by mask option.
- Memory
 - 2048×16 bit program ROM (including $2K \times 4$ bit look-up table)
 - 128×4 bit data RAM (including 16 working registers)
 - 16×4 LCD data RAM
- 14 input/output pins
 - Ports for input only: 1 ports/4 pins
 - Input/output ports: 2 ports/8 pins
 - MFP different output pin: 2 pin (MFP & MFPB)
 - 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)
- Five types of interrupts
 - Four internal interrupts (Divider 0, Divider 1, Timer 0, Timer 1)
 - One external interrupt (Port RC)
- LCD driver output
 - 16 segment \times 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

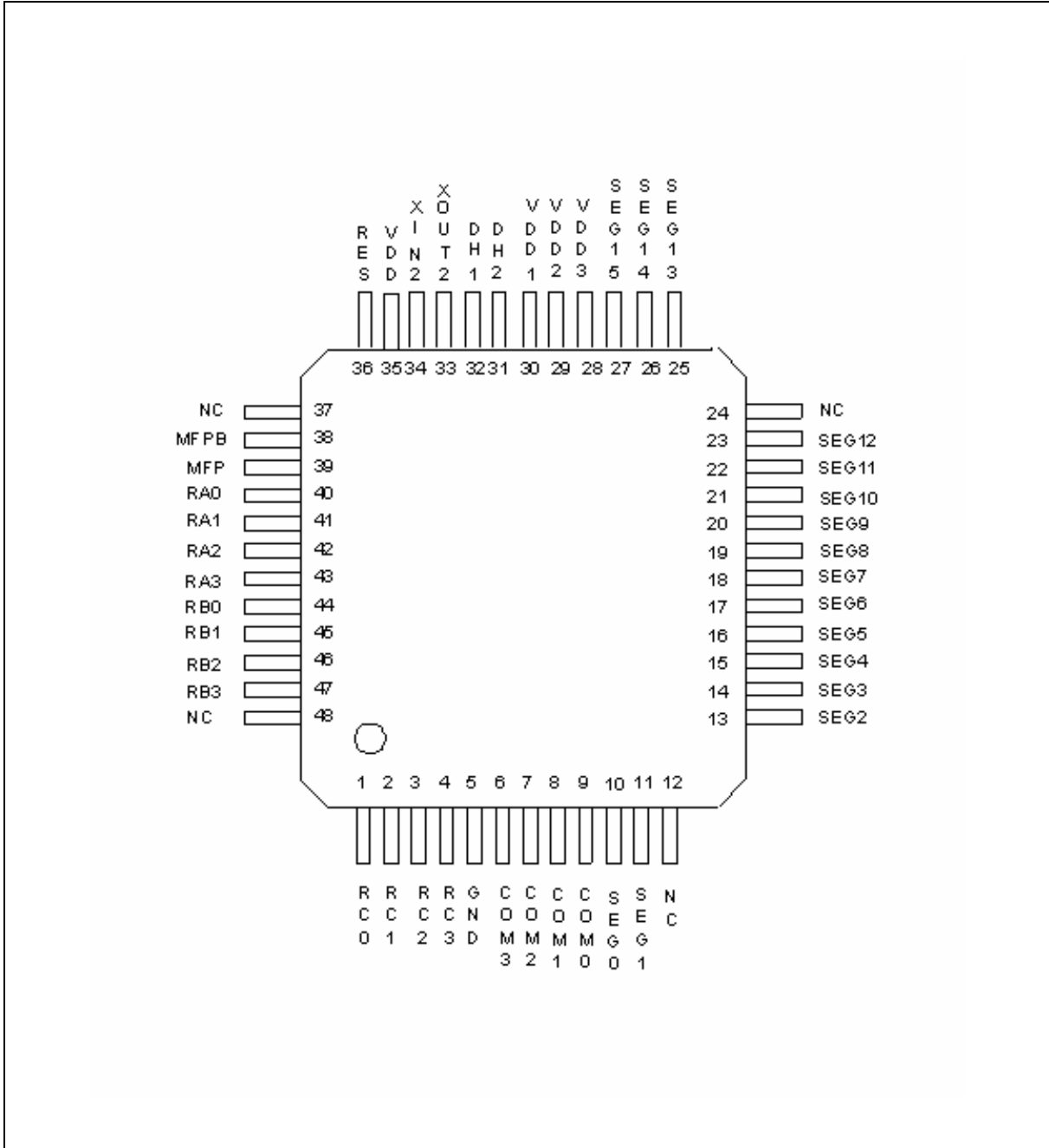
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- MFP output pin
 - Output is software selectable as modulating or nonmodulating frequency
 - Works as frequency output specified by Timer 1
- MFPB is MFP's inverse output of MFP pin
- Two built-in 14-bit clock frequency divider circuit (divider 0 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 1 μ S instruction cycle (with 4 MHz operating frequency)
- Package type is 48-pin LQFP

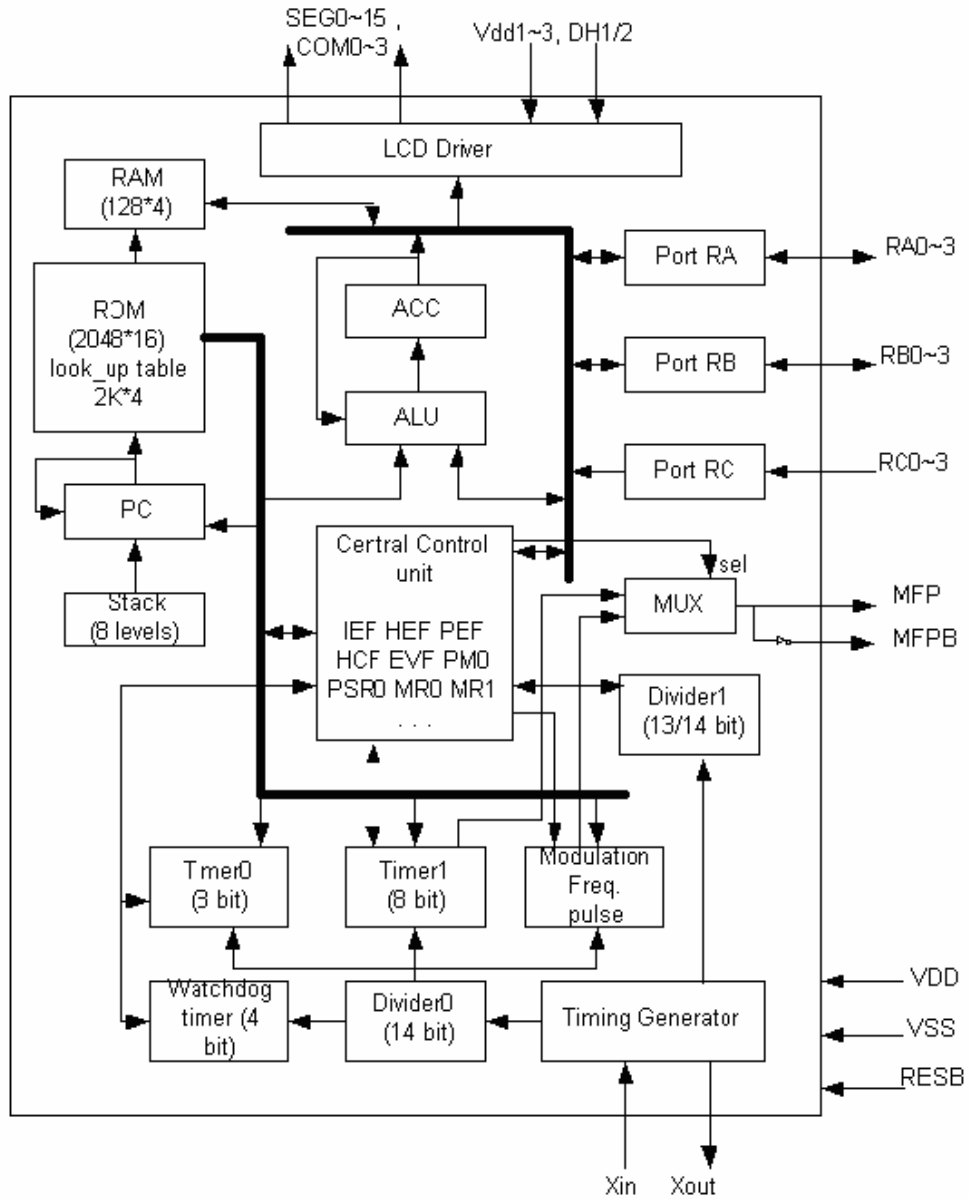


3. PIN CONFIGURATION





4. BLOCK DIAGRAM





5. PIN DESCRIPTION

SYMBOL	I/O	FUNCTION																									
XIN	I	Input pin for sub-oscillator. Connected to a. External 5~20pF capacitor uses to get accurate freq in crystal mode.																									
XOUT	O	Output pin for sub-oscillator. Connected to a 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																									
MFP	O	Output pin only. This pin can output modulating or nonmodulating frequency, or Timer 1 clock output specified by mode register 1 (MR1).																									
MFPB	O	Output pin only. This pin is inverse output of MFP pin.																									
$\overline{\text{RES}}$	I	System reset pin with pull-high resistor.																									
SEG0~SEG15	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" style="margin-left: auto; margin-right: auto;"> <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. D.C. Characteristics

($V_{DD}-V_{SS} = 3.0V$, $F_m = 2\text{ MHz}$, $F_s = 32.768\text{ KHz}$, $T_A = 25^\circ\text{ C}$, LCD on; unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Op. Voltage	V_{DD}	-	2.4	-	5.5	V
Op. Current	IOP1	No load (Ext-V) In dual-clock normal operation	-	150	400	μA
Hold Current	IHM1	Hold mode No load (Ext-V) In dual-clock normal operation	-	60	120	μA
Hold Current	IHM2	Hold mode No load (Ext-V) In dual-clock slow operation and F_m is stopped	-	3	6	μA
Input Low Voltage	V_{IL}	-	V_{SS}	-	$0.3 V_{DD}$	V
Input High Voltage	V_{IH}	-	$0.7 V_{DD}$	-	V_{DD}	V
MFP Output Low Voltage	V_{ML}	$I_{OL} = 2.7\text{ mA}$	-	-	0.4	V
MFP Output High Voltage	V_{MH}	$I_{OH} = 2.7\text{ mA}$	2.4	-	-	V
Port RA/RB Output Low Voltage	V_{ABL}	$I_{OL} = 2.0\text{ mA}$	-	-	0.4	V
Port RA/RB Output High Voltage	V_{ABH}	$I_{OH} = 2.0\text{ mA}$	2.4	-	-	V

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D.C. Characteristics, continue

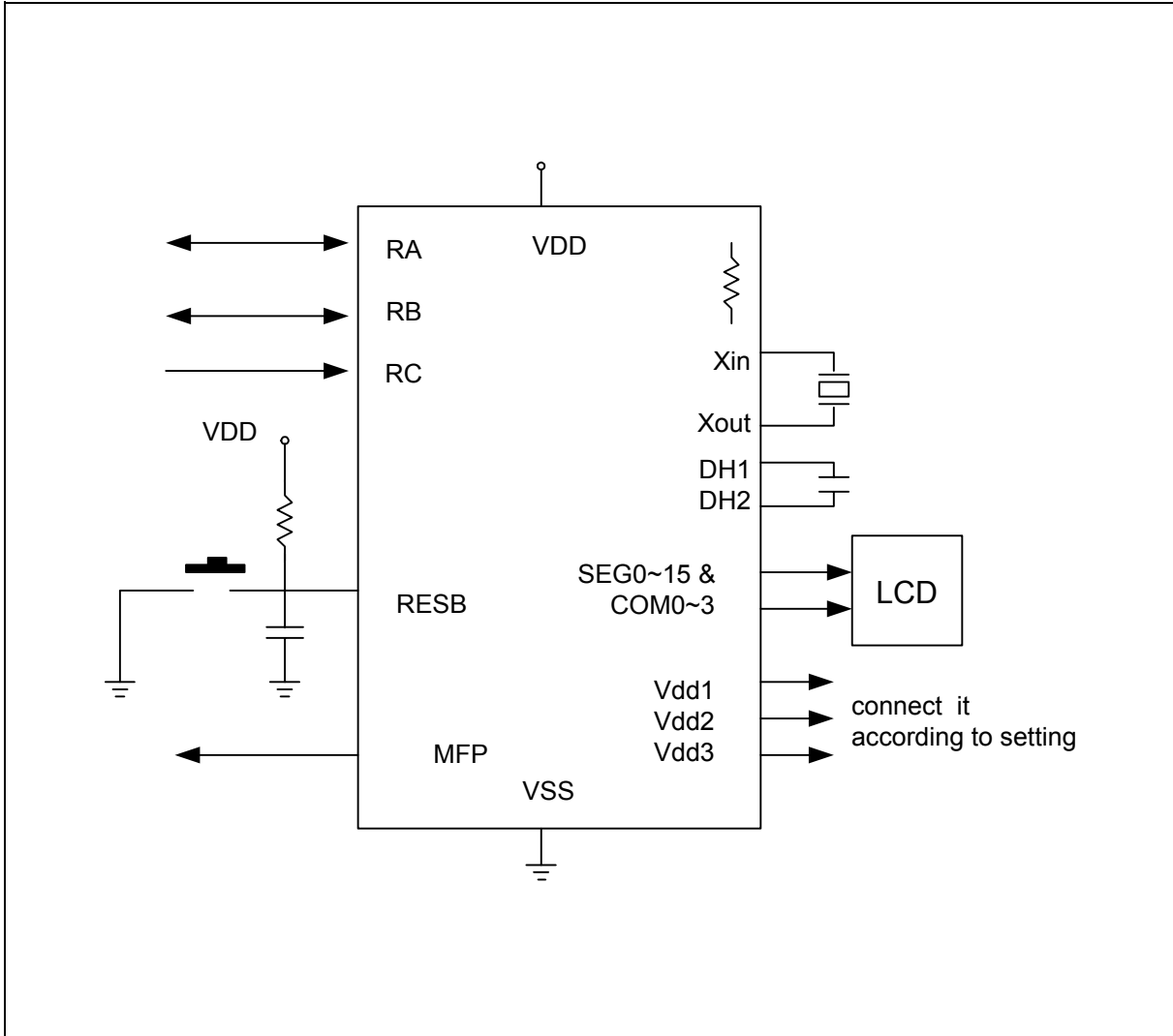
PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
LCD Supply Current	ILCD	All Seg. ON	-	-	6	μA
SEG0–SEG15 Sink Current (Used as LCD Output)	IOL1	VOL = 0.4V VLCD = 0.0V	0.4	-	-	μA
SEG0–SEG15 Drive Current (Used as LCD Output)	IOH1	VOH = 2.4V VLCD = 3.0V	0.3	-	-	μA
Segment Output Low Voltage (Used as DC Output)	VSL	IOL = 0.6 mA	-	-	0.4	V
Segment Output High Voltage (Used as DC Output)	VSH	IOH = 3 μA	2.4	-	-	V
Input Port Pull-up Resistor	RCD	Port RC	100	250	500	KΩ
RES Pull-up Resistor	RRES	-	50	130	250	KΩ

6.3. A.C. Characteristics

(VDD–VSS = 3.0V, TA = 25° C, unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Op. Frequency	FOSC	RC type	-	-	4000	
		Crystal type 1 (Option low speed type)	-	32.768	-	KHz
Frequency Deviation by Voltage Drop for 2MHz RC Oscillator	$\frac{\Delta f}{f}$	$\frac{f(3V) - f(2.4V)}{f(3V)}$	-	-	20	%
Instruction Cycle Time	Ti	One machine cycle	-	$\frac{4}{FOS_C}$	-	mS
Reset Active Width	TRAW	FOSC = 32.768 KHz	1	-	-	μS
Interrupt Active Width	TIAW	FOSC = 32.768 KHz	1	-	-	μS

7. TYPICAL APPLICATION CIRCUIT





8. REVISION HISTORY

VERSION	DATE	PAGE	REASONS FOR CHANGE
A1	July, 2004	-	New Create



Headquarters

No. 4, Creation Rd. III,
Science-Based Industrial Park,
Hsinchu, Taiwan
TEL: 886-3-5770066
FAX: 886-3-5665577
<http://www.winbond.com.tw/>

Taipei Office

9F, No.480, Rueiguang Rd.,
Neihu District, Taipei, 114,
Taiwan, R.O.C.
TEL: 886-2-8177-7168
FAX: 886-2-8751-3579

Winbond Electronics Corporation America

2727 North First Street, San Jose,
CA 95134, U.S.A.
TEL: 1-408-9436666
FAX: 1-408-5441798

Winbond Electronics Corporation Japan

7F Daini-ueno BLDG, 3-7-18
Shinyokohama Kohoku-ku,
Yokohama, 222-0033
TEL: 81-45-4781881
FAX: 81-45-4781800

Winbond Electronics (Shanghai) Ltd.

27F, 2299 Yan An W. Rd. Shanghai,
200336 China
TEL: 86-21-62365999
FAX: 86-21-62365998

Winbond Electronics (H.K.) Ltd.

Unit 9-15, 22F, Millennium City,
No. 378 Kwun Tong Rd.,
Kowloon, Hong Kong
TEL: 852-27513100
FAX: 852-27552064

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