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What is "[Embedded - Microcontrollers](#)"?

"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "[Embedded - Microcontrollers](#)"

Details

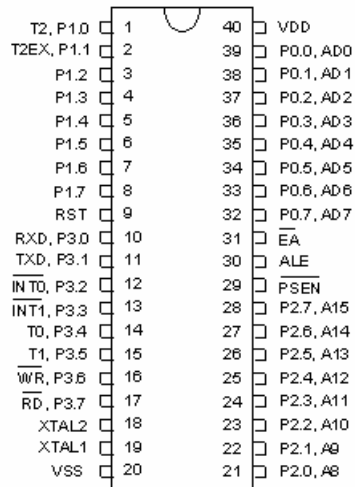
Product Status	Obsolete
Core Processor	8051
Core Size	8-Bit
Speed	24MHz
Connectivity	EBI/EMI, UART/USART
Peripherals	POR, WDT
Number of I/O	36
Program Memory Size	8KB (8K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	256 x 8
Voltage - Supply (Vcc/Vdd)	2.4V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	0°C ~ 70°C (TA)
Mounting Type	Surface Mount
Package / Case	44-LCC (J-Lead)
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/nuvoton-technology-corporation-america/w78l052c24pl

W78LE52C/W78L052C

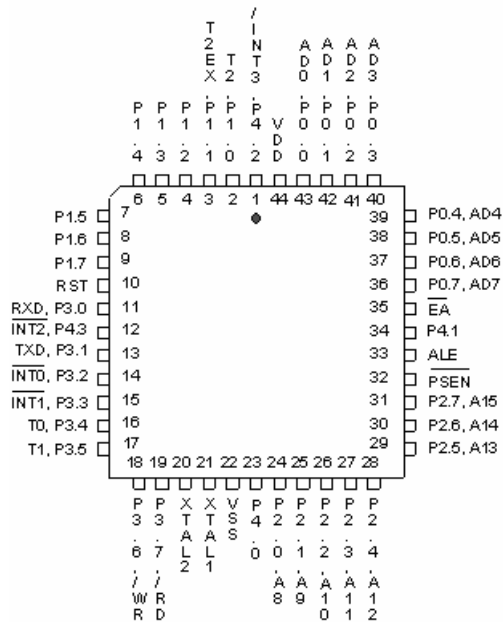


3. PIN CONFIGURATIONS

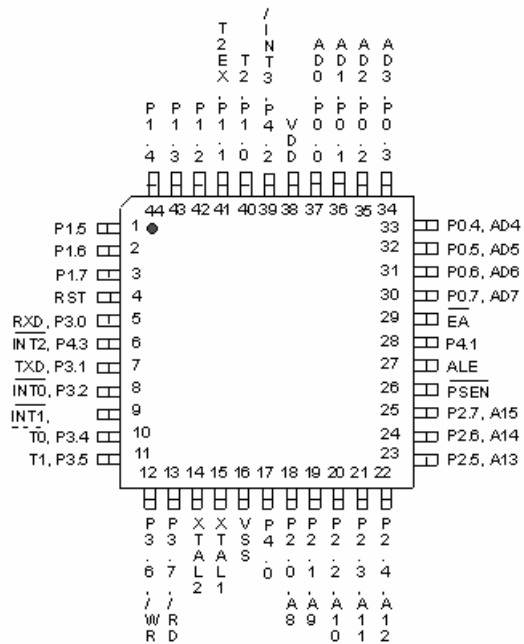
40-Pin DIP



44-Pin PLCC



44-Pin QFP





4. PIN DESCRIPTION

SYMBOL	DESCRIPTIONS
\overline{EA}	EXTERNAL ACCESS ENABLE: This pin forces the processor to execute out of external ROM. It should be kept high to access internal ROM. The ROM address and data will not be presented on the bus if \overline{EA} pin is high and the program counter is within on-chip ROM area.
\overline{PSEN}	PROGRAM STORE ENABLE: \overline{PSEN} enables the external ROM data onto the Port 0 address/ data bus during fetch and MOV _C operations. When internal ROM access is performed, no \overline{PSEN} strobe signal outputs from this pin.
ALE	ADDRESS LATCH ENABLE: ALE is used to enable the address latch that separates the address from the data on Port 0.
RST	RESET: A high on this pin for two machine cycles while the oscillator is running resets the device.
XTAL1	CRYSTAL1: This is the crystal oscillator input. This pin may be driven by an external clock.
XTAL2	CRYSTAL2: This is the crystal oscillator output. It is the inversion of XTAL1.
VSS	GROUND: Ground potential
VDD	POWER SUPPLY: Supply voltage for operation.
P0.0–P0.7	PORT 0: Port 0 is a bi-directional I/O port which also provides a multiplexed low order address/data bus during accesses to external memory. The Port 0 is also an open-drain port and external pull-ups need to be connected while in programming.
P1.0–P1.7	PORT 1: Port 1 is a bi-directional I/O port with internal pull-ups. The bits have alternate functions which are described below: T2(P1.0): Timer/Counter 2 external count input T2EX(P1.1): Timer/Counter 2 Reload/Capture control
P2.0–P2.7	PORT 2: Port 2 is a bi-directional I/O port with internal pull-ups. This port also provides the upper address bits for accesses to external memory.
P3.0–P3.7	PORT 3: Port 3 is a bi-directional I/O port with internal pull-ups. All bits have alternate functions, which are described below: RXD(P3.0) : Serial Port receiver input TXD(P3.1) : Serial Port transmitter output INT $\overline{0}$ (P3.2) : External Interrupt 0 INT $\overline{1}$ (P3.3) : External Interrupt 1 T0(P3.4) : Timer 0 External Input T1(P3.5) : Timer 1 External Input \overline{WR} (P3.6) :External Data Memory Write Strobe \overline{RD} (P3.7) : External Data Memory Read Strobe
P4.0–P4.3	PORT 4: Another bit-addressable bidirectional I/O port P4. P4.3 and P4.2 are alternative function pins. It can be used as general I/O port or external interrupt input sources (INT2 /INT3).

**Eight-source interrupt informations:**

INTERRUPT SOURCE	VECTOR ADDRESS	POLLING SEQUENCE WITHIN PRIORITY LEVEL	ENABLE REQUIRED SETTINGS	INTERRUPT TYPE EDGE/LEVEL
External Interrupt 0	03H	0 (highest)	IE.0	TCON.0
Timer/Counter 0	0BH	1	IE.1	-
External Interrupt 1	13H	2	IE.2	TCON.2
Timer/Counter 1	1BH	3	IE.3	-
Serial Port	23H	4	IE.4	-
Timer/Counter 2	2BH	5	IE.5	-
External Interrupt 2	33H	6	XICON.2	XICON.0
External Interrupt 3	3BH	7 (lowest)	XICON.6	XICON.3

2. PORT4

Another bit-addressable port P4 is also available and only 4 bits (P4<3:0>) can be used. This port address is located at 0D8H with the same function as that of port P1, except the P4.3 and P4.2 are alternative function pins. It can be used as general I/O pins or external interrupt input sources (INT2, INT3).

Example:

```

P4      REG    0D8H
MOV     P4, #0AH    ; Output data "A" through P4.0–P4.3.
MOV     A, P4       ; Read P4 status to Accumulator.
ORL     P4.#00000001B ; Set P4.0 to be high state.
ANL     P4.#11111110B ; Clear P4.0 to be low state.

```

3. Reduce EMI Emission

Because of on-chip Flash EPROM, when a program is running in internal ROM space, the ALE will be unused. The transition of ALE will cause noise, so it can be turned off to reduce the EMI emission if it is useless. Turning off the ALE signal transition only requires setting the bit 0 of the AUXR SFR, which is located at 08Eh. When ALE is turned off, it will be reactivated when the program accesses external ROM/RAM data or jumps to execute an external ROM code. The ALE signal will turn off again after it has been completely accessed or the program returns to internal ROM code space. The AO bit in the AUXR register, when set, disables the ALE output. In order to reduce EMI emission from oscillation circuitry, W78L052C allows user to diminish the gain of on-chip oscillator amplifiers by using programmer to clear the B7 bit of security register. Once B7 is set to 0, a half of gain will be decreased. Care must be taken if user attempts to diminish the gain of oscillator amplifier, reducing a half of gain may affect the external crystal operating improperly at high frequency above 20MHz. The value of R and C1, C2 may need some adjustment while running at lower gain.

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***AUXR - Auxiliary register (8EH)

-	-	-	-	-	-	-	AO
---	---	---	---	---	---	---	----

AO: Turn off ALE output.

4. Power-off Flag

***PCON - Power control (87H)

-	-	-	POF	GF1	GF0	PD	IDL
---	---	---	-----	-----	-----	----	-----

POF: Power off flag. Bit is set by hardware when power on reset. It can be cleared by software to determine chip reset is a warm boot or cold boot.

GF1, GF0: These two bits are general-purpose flag bits for the user.

PD: Power down mode bit. Set it to enter power down mode.

IDL: Idle mode bit. Set it to enter idle mode.

The power-off flag is located at PCON.4. This bit is set when VDD has been applied to the part. It can be used to determine if a reset is a warm boot or a cold boot if it is subsequently reset by software.

Watchdog Timer

The Watchdog timer is a free-running timer which can be programmed by the user to serve as a system monitor, a time-base generator or an event timer. It is basically a set of dividers that divide the system clock. The divider output is selectable and determines the time-out interval. When the time-out occurs a system reset can also be caused if it is enabled. The main use of the Watchdog timer is as a system monitor. This is important in real-time control applications. In case of power glitches or electro-magnetic interference, the processor may begin to execute errant code. If this is left unchecked the entire system may crash. The watchdog time-out selection will result in different time-out values depending on the clock speed. The Watchdog timer will be disabled on reset. In general, software should restart the Watchdog timer to put it into a known state. The control bits that support the Watchdog timer are discussed below.

Watchdog Timer Control Register

Bit:	7	6	5	4	3	2	1	0
	ENW	CLRW	WIDL	-	-	PS2	PS1	PS0

Mnemonic: WDTC

Address: 8FH

ENW : Enable watch-dog if set.

CLRW : Clear watch-dog timer and prescaler if set. This flag will be cleared automatically

WIDL : If this bit is set, watch-dog is enabled under IDLE mode. If cleared, watch-dog is disabled under IDLE mode. Default is cleared.

PS2, PS1, PS0: Watch-dog prescaler timer select. Prescaler is selected when set PS2–0 as follows:

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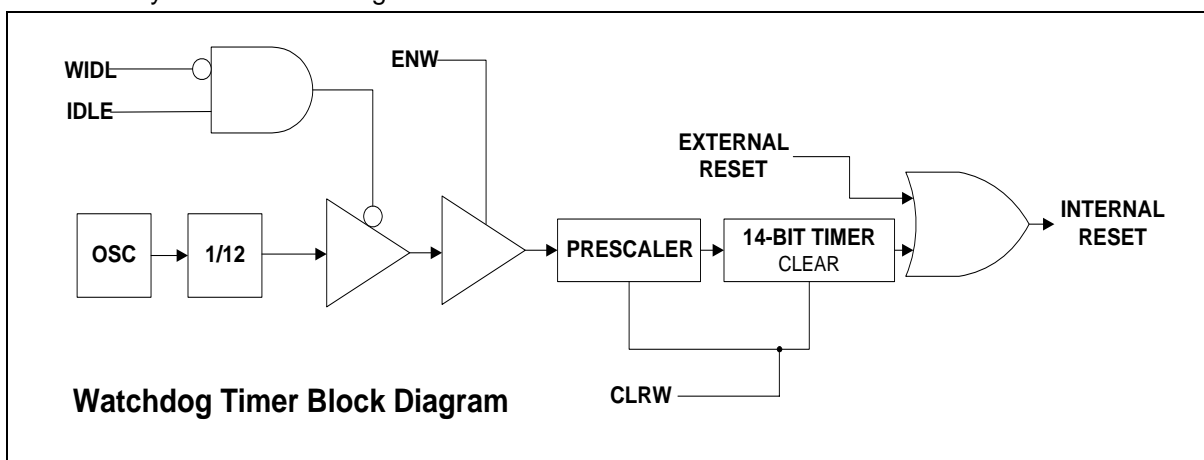


PS2 PS1 PS0	PRESCALER SELECT
0 0 0	2
0 0 1	4
0 1 0	8
0 1 1	16
1 0 0	32
1 0 1	64
1 1 0	128
1 1 1	256

The time-out period is obtained using the following equation:

$$\frac{1}{\text{OSC}} \times 2^{14} \times \text{PRESCALER} \times 1000 \times 12 \text{ mS}$$

Before Watchdog time-out occurs, the program must clear the 14-bit timer by writing 1 to WDTC.6 (CLR W). After 1 is written to this bit, the 14-bit timer, prescaler and this bit will be reset on the next instruction cycle. The Watchdog timer is cleared on reset.



Typical Watch-Dog time-out period when OSC = 20 MHz

PS2 PS1 PS0	WATCHDOG TIME-OUT PERIOD
0 0 0	19.66 mS
0 1 0	39.32 mS
0 0 1	78.64 mS
0 1 1	157.28 mS
1 0 0	314.57 mS
1 0 1	629.14 mS
1 1 0	1.25 S
1 1 1	2.50 S

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Clock

The W78L052C is designed to be used with either a crystal oscillator or an external clock. Internally, the clock is divided by two before it is used. This makes the W78L052C relatively insensitive to duty cycle variations in the clock. The W78L052C incorporates a built-in crystal oscillator. To make the oscillator work, a crystal must be connected across pins XTAL1 and XTAL2. In addition, a load capacitor must be connected from each pin to ground. An external clock source should be connected to pin XTAL1. Pin XTAL2 should be left unconnected. The XTAL1 input is a CMOS-type input, as required by the crystal oscillator.

Power Management

Idle Mode

The idle mode is entered by setting the IDL bit in the PCON register. In the idle mode, the internal clock to the processor is stopped. The peripherals and the interrupt logic continue to be clocked. The processor will exit idle mode when either an interrupt or a reset occurs.

Power-down Mode

When the PD bit of the PCON register is set, the processor enters the power-down mode. In this mode all of the clocks are stopped, including the oscillator. The only way to exit power-down mode is by a reset.

Reset

The external RESET signal is sampled at S5P2. To take effect, it must be held high for at least two machine cycles while the oscillator is running. An internal trigger circuit in the reset line is used to deglitch the reset line when the W78L052C is used with an external RC network. The reset logic also has a special glitch removal circuit that ignores glitches on the reset line.

During reset, the ports are initialized to FFH, the stack pointer to 07H, PCON (with the exception of bit 4) to 00H, and all of the other SFR registers except SBUF to 00H. SBUF is not reset.

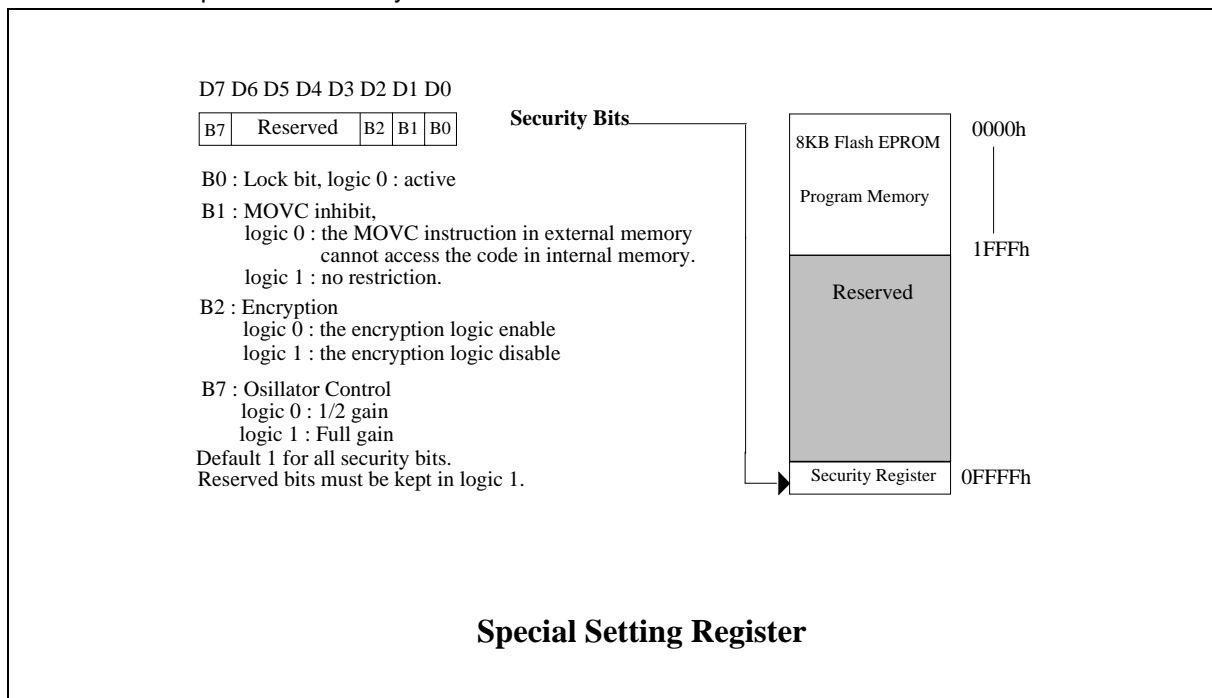


6. ON-CHIP FLASH EPROM CHARACTERISTICS

7. SECURITY BITS

During the on-chip Flash EPROM operation mode, the Flash EPROM can be programmed and verified repeatedly. Until the code inside the Flash EPROM is confirmed OK, the code can be protected. The protection of Flash EPROM and those operations on it are described below.

The W78L052C has a Special Setting Register, the Security Register, which can not be accessed in normal mode. The Security register can only be accessed from the Flash EPROM operation mode. Those bits of the Security Registers can not be changed once they have been programmed from high to low. They can only be reset through erase-all operation. The Security Register is addressed in the Flash EPROM operation mode by address #0FFFFh.



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Lock bit

This bit is used to protect the customer's program code in the W78L052C. It may be set after the programmer finishes the programming and verifies sequence. Once this bit is set to logic 0, both the Flash EPROM data and Special Setting Registers can not be accessed again.

MOVC Inhibit

This bit is used to restrict the accessible region of the MOVC instruction. It can prevent the MOVC instruction in external program memory from reading the internal program code. When this bit is set to logic 0, a MOVC instruction in external program memory space will be able to access code only in the external memory, not in the internal memory. A MOVC instruction in internal program memory space will always be able to access the ROM data in both internal and external memory. If this bit is logic 1, there are no restrictions on the MOVC instruction.

Encryption

This bit is used to enable/disable the encryption logic for code protection. Once encryption feature is enabled, the data presented on port 0 will be encoded via encryption logic. Only whole chip erase will reset this bit.

8. ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
DC Power Supply	V _{DD} -V _{SS}	-0.3	+7.0	V
Input Voltage	V _{IN}	V _{SS} -0.3	V _{DD} +0.3	V
Operating Temperature	T _A	0	70	°C
Storage Temperature	T _{ST}	-55	+150	°C

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



9. DC CHARACTERISTICS

V_{SS} = 0V, T_A = 25° C, unless otherwise specified.

PARAMETER	SYM.	SPECIFICATION		UNIT	TEST CONDITIONS
		MIN.	MAX.		
Operating Voltage	V _{DD}	2.4	5.5	V	
Operating Current	I _{DD}	-	20	mA	No load V _{DD} = 5.5V
		-	3	mA	No load V _{DD} = 2.4V
Idle Current	I _{IDLE}	-	6	mA	V _{DD} = 5.5V, F _{OSC} = 20 MHz
		-	1.5	mA	V _{DD} = 2.4V, F _{OSC} = 12 MHz
Power Down Current	I _{PWDN}	-	50	μA	V _{DD} = 5.5V, F _{OSC} = 20 MHz
		-	20	μA	V _{DD} = 2.4V, F _{OSC} = 12 MHz
Input Current P1, P2, P3, P4	I _{IN1}	-50	+10	μA	V _{DD} = 5.5V V _{IN} = 0V or V _{DD}
Input Current RST	I _{IN2}	-10	+300	μA	V _{DD} = 5.5V 0 < V _{IN} < V _{DD}
Input Leakage Current P0, $\overline{\text{EA}}$	I _{LK}	-10	+10	μA	V _{DD} = 5.5V 0V < V _{IN} < V _{DD}
Logic 1 to 0 Transition Current P1, P2, P3, P4	I _{TL} [*4]	-500	-	μA	V _{DD} = 5.5V V _{IN} = 2.0V
Input Low Voltage P0, P1, P2, P3, P4, $\overline{\text{EA}}$	V _{IL1}	0	0.8	V	V _{DD} = 4.5V
		0	0.5	V	V _{DD} = 2.4V
Input Low Voltage RST[*1]	V _{IL2}	0	0.8	V	V _{DD} = 4.5V
		0	0.3	V	V _{DD} = 2.4V
Input High Voltage P1, P2, P3, P4, $\overline{\text{EA}}$	V _{IH1}	2.4	V _{DD} +0.2	V	V _{DD} = 5.5V
		1.4	V _{DD} +0.2	V	V _{DD} = 2.4V
Input High Voltage XTAL1 [*3]	V _{IH3}	3.5	V _{DD} +0.2	V	V _{DD} = 5.5V
		1.6	V _{DD} +0.2	V	V _{DD} = 2.4V
Output Low Voltage P1, P2, P3, P4	V _{OL1}	-	0.45	V	V _{DD} = 4.5V, I _{OL} = +2 mA
		-	0.25	V	V _{DD} = 2.4V, I _{OL} = +1 mA
Output Low Voltage P0, ALE, $\overline{\text{PSEN}}$ [*2]	V _{OL2}	-	0.45	V	V _{DD} = 4.5V, I _{OL} = +4 mA
		-	0.25	V	V _{DD} = 2.4V, I _{OL} = +2 mA
Sink Current P1, P2, P3, P4	I _{SK1}	4	12	mA	V _{DD} = 4.5V, V _{IN} = 0.45V
		1.8	5.4	mA	V _{DD} = 2.4V, V _{IN} = 0.45V
Sink Current P0, ALE, $\overline{\text{PSEN}}$	I _{SK2}	8	16	mA	V _{DD} = 4.5V, V _{IN} = 0.45V
		4.0	9	mA	V _{DD} = 2.4V, V _{IN} = 0.45V
Output High Voltage P1, P2, P3, P4	V _{OH1}	2.4	-	V	V _{DD} = 4.5V, I _{OH} = -100 μA
		1.4	-	V	V _{DD} = 2.4V, I _{OH} = -8 μA

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DC Characteristics, continued

PARAMETER	SYM.	SPECIFICATION		UNIT	TEST CONDITIONS
		MIN.	MAX.		
Output High Voltage P0, ALE, $\overline{\text{PSEN}}$ [*2]	VOH2	2.4	-	V	VDD = 4.5V, IOH = -400 μA
		1.4	-	V	VDD = 2.4V, IOH = -200 μA
Source Current P1, P2, P3, P4	ISR1	-100	-250	μA	VDD = 4.5V, Vin = 2.4V
		-10	-30	μA	VDD = 2.4V, Vin = 1.4V
Source Current P0, ALE, $\overline{\text{PSEN}}$	ISR2	-8	-14	mA	VDD = 4.5V, Vin = 2.4V
		-1.0	-2.4	mA	VDD = 2.4V, Vin = 1.4V

Notes:

*1. RST pin is a Schmitt trigger input.

*2. P0, ALE and $\overline{\text{PSEN}}$ are tested in the external access mode.

*3. XTAL1 is a CMOS input.

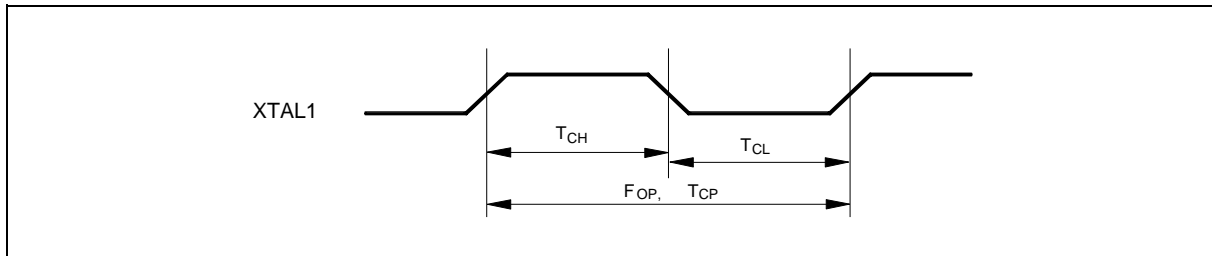
*4. Pins of P1, P2, P3, P4 can source a transition current when they are being externally driven from 1 to 0.



10. AC CHARACTERISTICS

The AC specifications are a function of the particular process used to manufacture the part, the ratings of the I/O buffers, the capacitive load, and the internal routing capacitance. Most of the specifications can be expressed in terms of multiple input clock periods (TCP), and actual parts will usually experience less than a ± 20 nS variation. The numbers below represent the performance expected from a 0.6micron CMOS process when using 2 and 4 mA output buffers.

Clock Input Waveform



PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTES
Operating Speed	FOP	0	-	20	MHz	1
Clock Period	TCP	50	-	-	nS	2
Clock High	TCH	25	-	-	nS	3
Clock Low	TCL	25	-	-	nS	3

Notes:

1. The clock may be stopped indefinitely in either state.
2. The TCP specification is used as a reference in other specifications.
3. There are no duty cycle requirements on the XTAL1 input.

Program Fetch Cycle

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTES
Address Valid to ALE Low	TAAS	1 TCP - Δ	-	-	nS	4
Address Hold from ALE Low	TAAH	1 TCP - Δ	-	-	nS	1, 4
ALE Low to $\overline{\text{PSEN}}$ Low	TAPL	1 TCP - Δ	-	-	nS	4
$\overline{\text{PSEN}}$ Low to Data Valid	TPDA	-	-	2 TCP	nS	2
Data Hold after $\overline{\text{PSEN}}$ High	TPDH	0	-	1 TCP	nS	3
Data Float after $\overline{\text{PSEN}}$ High	TPDZ	0	-	1 TCP	nS	
ALE Pulse Width	TALW	2 TCP - Δ	2 TCP	-	nS	4
$\overline{\text{PSEN}}$ Pulse Width	TPSW	3 TCP - Δ	3 TCP	-	nS	4

Notes:

1. P0.0–P0.7, P2.0–P2.7 remain stable throughout entire memory cycle.
2. Memory access time is 3 TCP.
3. Data have been latched internally prior to $\overline{\text{PSEN}}$ going high.
4. " Δ " (due to buffer driving delay and wire loading) is 20 nS.

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Data Read Cycle

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTES
ALE Low to $\overline{\text{RD}}$ Low	TDAR	3 TCP - Δ	-	3 TCP + Δ	nS	1, 2
$\overline{\text{RD}}$ Low to Data Valid	TDDA	-	-	4 TCP	nS	1
Data Hold from $\overline{\text{RD}}$ High	TDDH	0	-	2 TCP	nS	
Data Float from $\overline{\text{RD}}$ High	TDDZ	0	-	2 TCP	nS	
$\overline{\text{RD}}$ Pulse Width	TDRD	6 TCP - Δ	6 TCP	-	nS	2

Notes:

1. Data memory access time is 8 TCP.
2. " Δ " (due to buffer driving delay and wire loading) is 20 nS.

Data Write Cycle

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
ALE Low to $\overline{\text{WR}}$ Low	TDAW	3 TCP - Δ	-	3 TCP + Δ	nS
Data Valid to $\overline{\text{WR}}$ Low	TDAD	1 TCP - Δ	-	-	nS
Data Hold from $\overline{\text{WR}}$ High	TDWD	1 TCP - Δ	-	-	nS
$\overline{\text{WR}}$ Pulse Width	TDWR	6 TCP - Δ	6 TCP	-	nS

Note: " Δ " (due to buffer driving delay and wire loading) is 20 nS.

Port Access Cycle

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Port Input Setup to ALE Low	TPDS	1 TCP	-	-	nS
Port Input Hold from ALE Low	TPDH	0	-	-	nS
Port Output to ALE	TPDA	1 TCP	-	-	nS

Note: Ports are read during S5P2, and output data becomes available at the end of S6P2. The timing data are referenced to ALE, since it provides a convenient reference.

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Program Operation

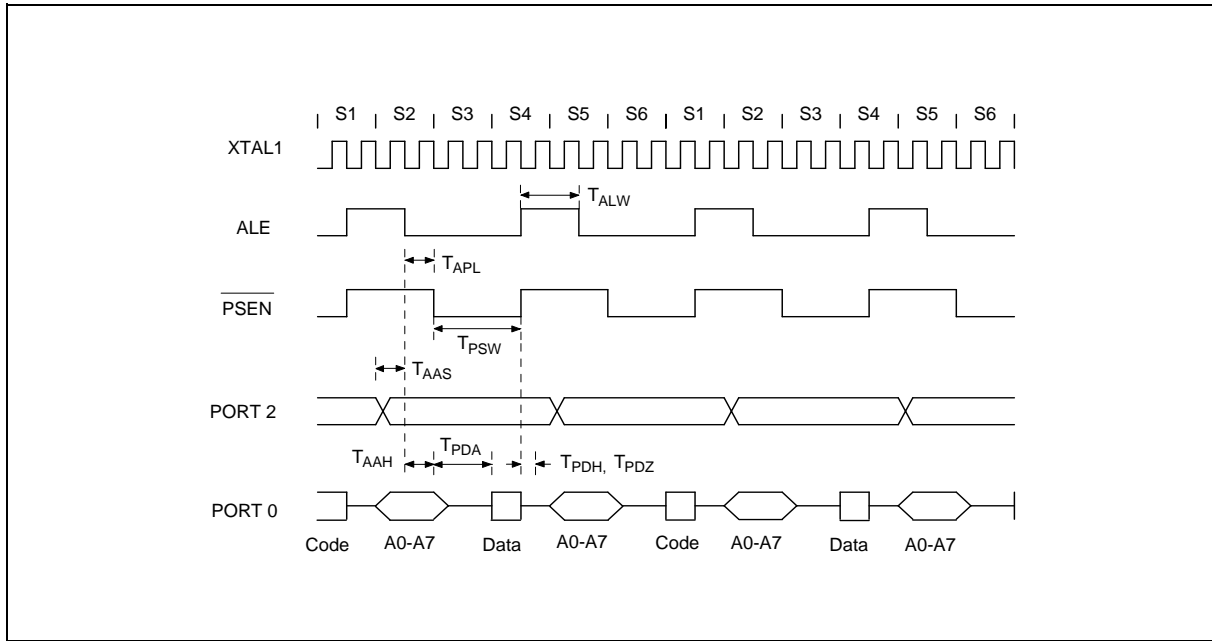
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
VPP Setup Time	TVPS	2.0	-	-	μ S
Data Setup Time	TDS	2.0	-	-	μ S
Data Hold Time	TDH	2.0	-	-	μ S
Address Setup Time	TAS	2.0	-	-	μ S
Address Hold Time	TAH	0	-	-	μ S
$\overline{\text{CE}}$ Program Pulse Width for Program Operation	TPWP	290	300	310	μ S
OCTRL Setup Time	TOCS	2.0	-	-	μ S
OCTRL Hold Time	TOCH	2.0	-	-	μ S
$\overline{\text{OE}}$ Setup Time	TOES	2.0	-	-	μ S
$\overline{\text{OE}}$ High to Output Float	TDFP	0	-	130	nS
Data Valid from $\overline{\text{OE}}$	TOEV	-	-	150	nS

Note: Flash data can be accessed only in flash mode. The RST pin must pull in V_{IH} status, the ALE pin must pull in V_{IL} status, and the $\overline{\text{PSEN}}$ pin must pull in V_{IH} status.

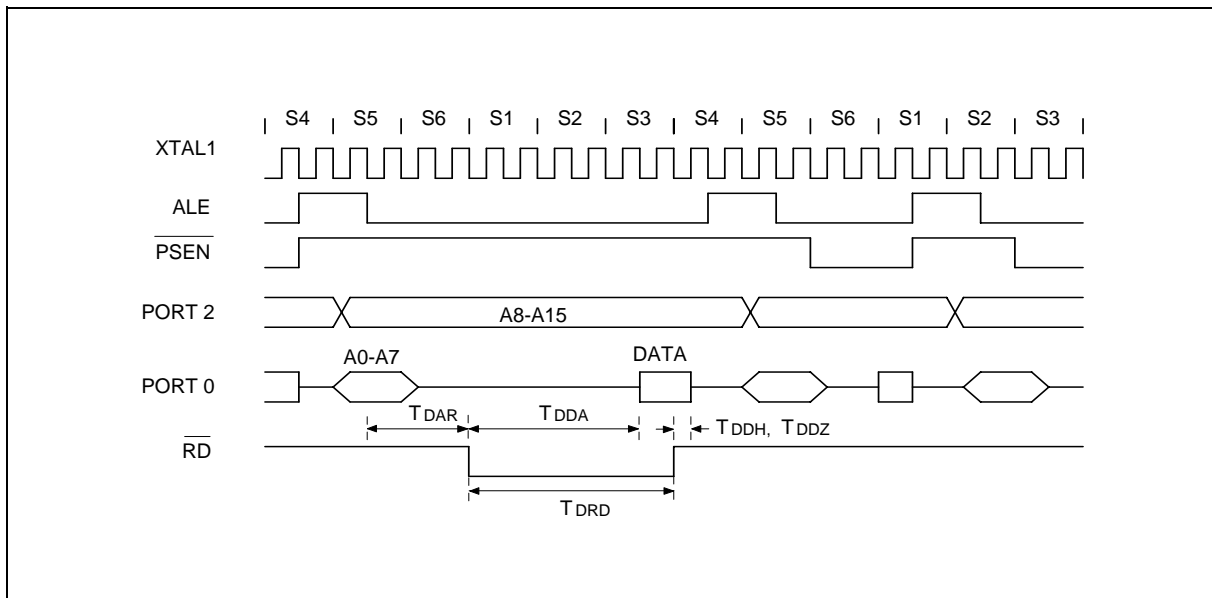


11. TIMING WAVEFORMS

Program Fetch Cycle



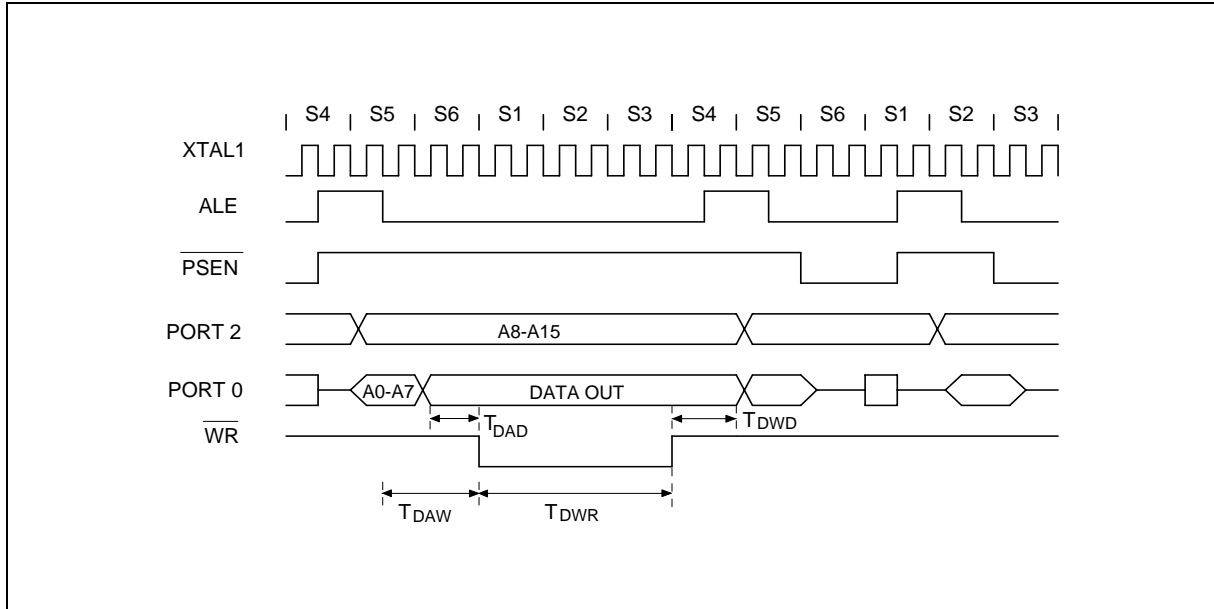
Data Read Cycle



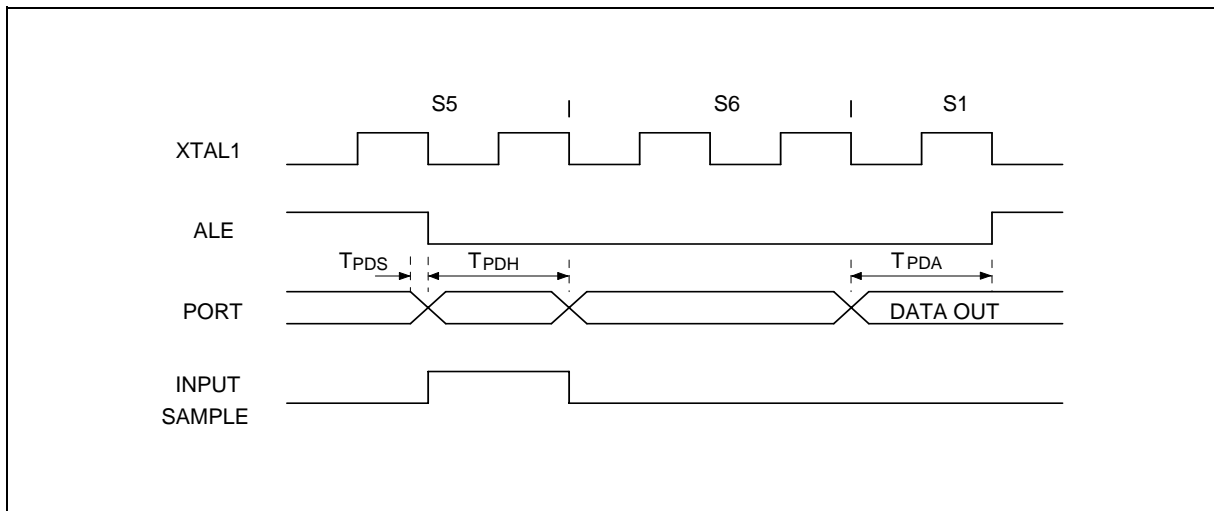
W78LE52C/W78L052C



Data Write Cycle



Port Access Cycle



W78LE52C/W78L052C



12. TYPICAL APPLICATION CIRCUITS

Expanded External Program Memory and Crystal

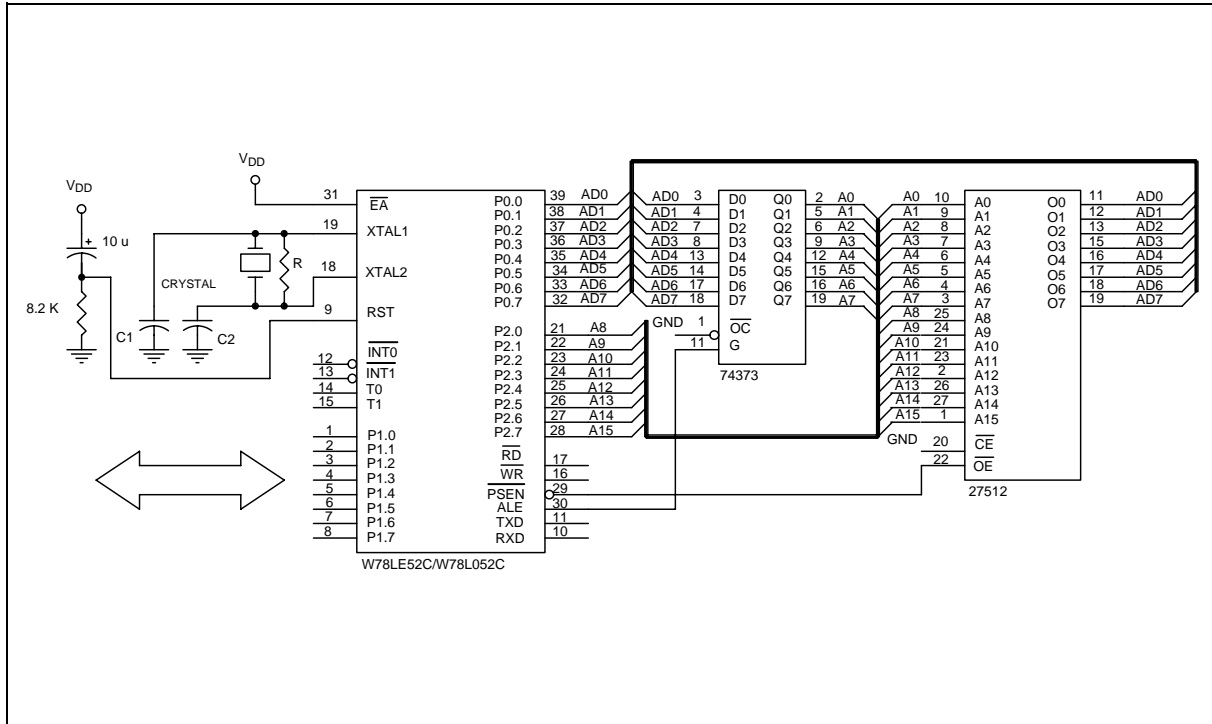


Figure A

CRYSTAL	C1	C2	R
16 MHz	30P	30P	-
20 MHz	15P	15P	-

Above table shows the reference values for crystal applications (full gain).

Note: C1, C2, R components refer to Figure A.

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Expanded External Data Memory and Oscillator

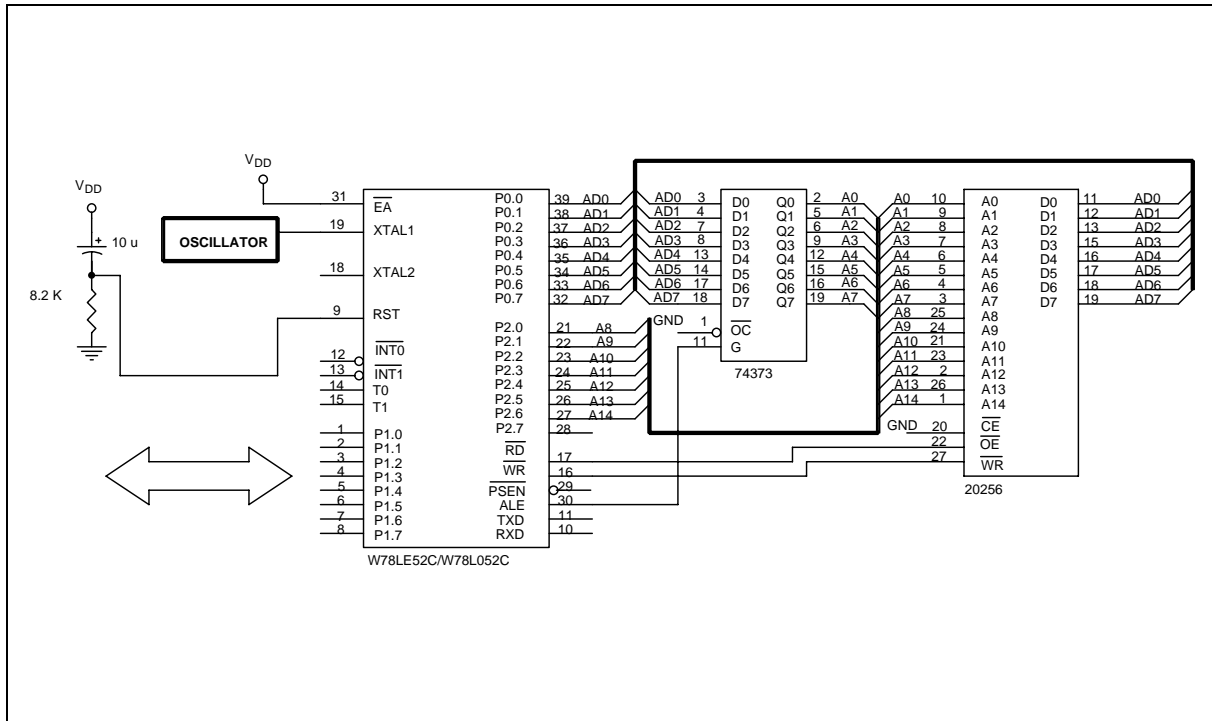


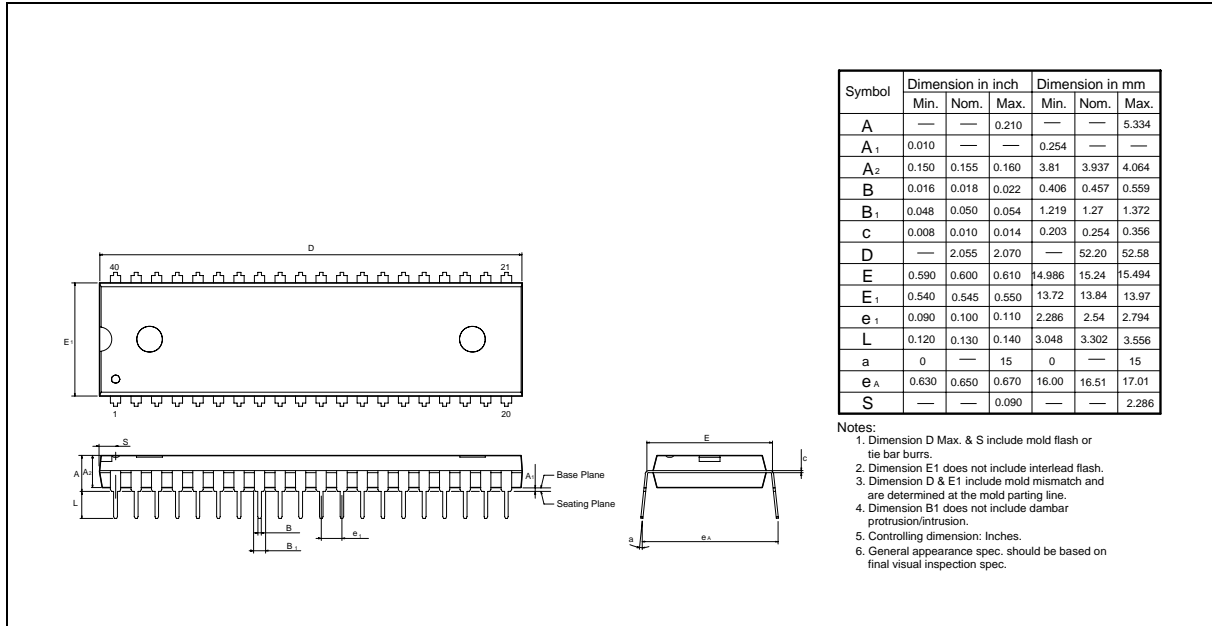
Figure B

W78LE52C/W78L052C

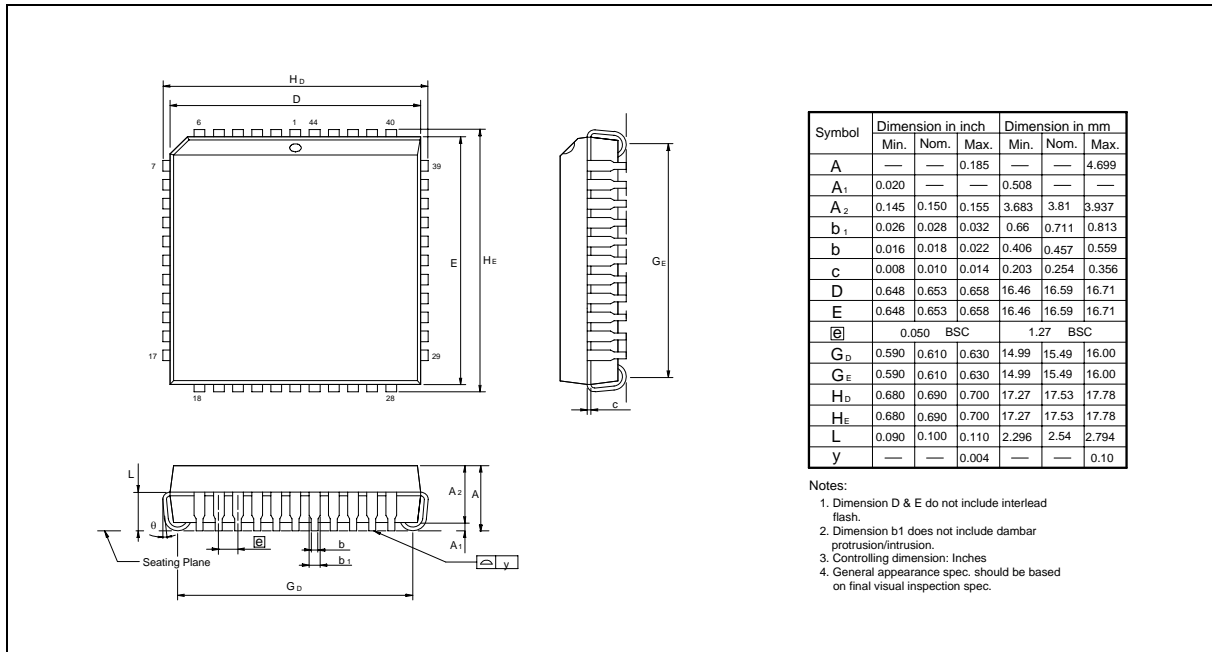


13. PACKAGE DIMENSIONS

40-pin DIP



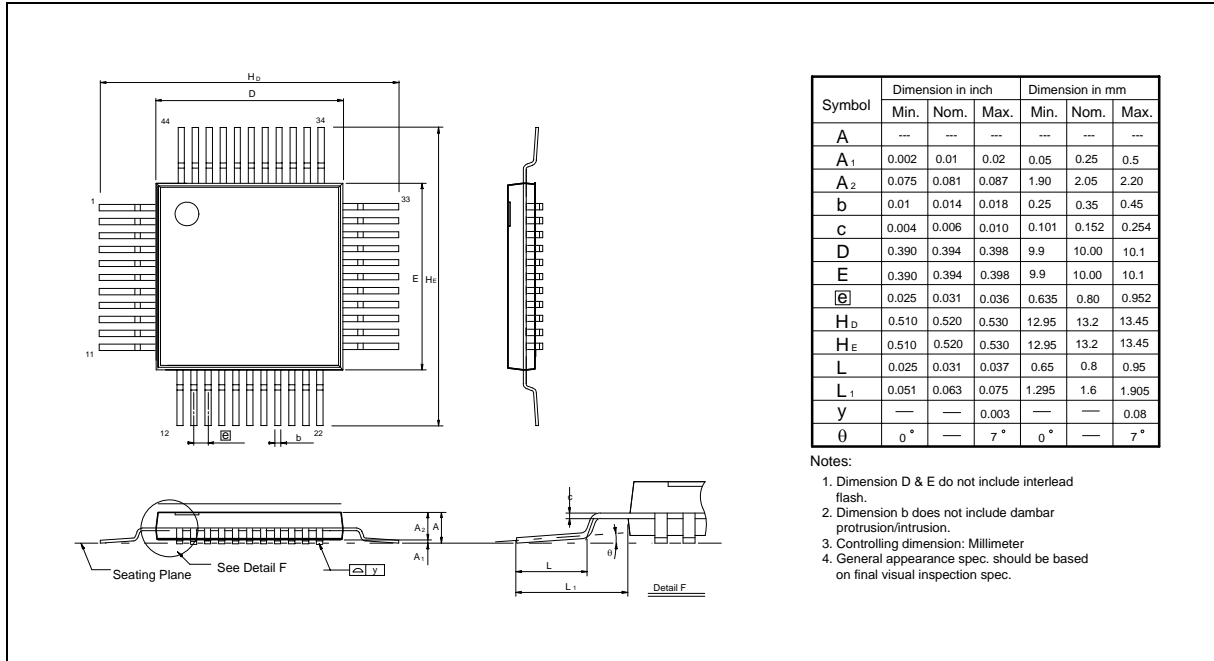
44-pin PLCC



W78LE52C/W78L052C



44-pin PQFP



**14. REVISION HISTORY**

VERSION	DATE	PAGE	REASONS FOR CHANGE
A1	May 20, 2005		Initial Issued
A2	October 2, 2006		Remove block diagram Change operating frequency into 20MHz
A3	December 4, 2006	2	Remove all Leaded package parts
A4	April 17, 2007	12	Add VIH1 DC spec

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