

PRELIMINARY W541E20X



4-BIT FLASH EPROM MICROCONTROLLER

GENERAL DESCRIPTION

The W541E20X is fully compatible with W741E20X in terms of pin assignment and IC function. It is a high-performance 4-bit microcontroller (μC) that provides an flash EEPROM for the program memory. The device contains a 4-bit ALU, two 8-bit timers, a divider, a serial port, and five 4-bit I/O ports (including 3 output port for LED driving). There are also seven interrupt sources and 8-level subroutine nesting for interrupt applications. The W541E20X has two power reduction modes, hold mode and stop mode, which help to minimize power dissipation.

The W541E20X is suitable for end product manufacturer engineering testing and earlier samples before mass production.

FEATURES

- Operating voltage: 2.4V–5.5V
- Crystal or RC oscillation circuit can be selected by the code option
 - Crystal/Ceramic oscillator: up to 4 MHz
 - RC oscillator: up to 4 MHz
- Both in crystal or RC oscillator operation mode, high-frequency (400 KHz to 4 MHz) or low-frequency (32.768 KHz) oscillation must be determined by the code option
- Memory
 - 2048 \times 16 bit program flash EEPROM (including 2K \times 4 bit look-up table)
 - 128 \times 4 bit data RAM (including 16 working registers)
- 21 input/output pins
 - Input/output ports: 4 ports/16 pins
 - Serial input/output port: 1 port /4 pins (high sink current for LED driving)
 - 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 oscillator)
- Seven types of interrupts
 - Five internal interrupts (Divider 0, Timer 0, Timer 1, and Serial I/O)
 - Two external interrupts (Port RC and $\overline{\text{INT}}$ pin)
- MFP output pin
 - Output is software selectable as modulating or nonmodulating frequency
 - Works as frequency output specified by Timer 1
- Built-in 14-bit clock frequency divider circuit
- Two built-in 8-bit programmable countdown timers
 - Timer 0: One of two internal clock frequencies ($F_{\text{OSC}}/4$ or $F_{\text{OSC}}/1024$) can be selected

Preliminary W541E20X

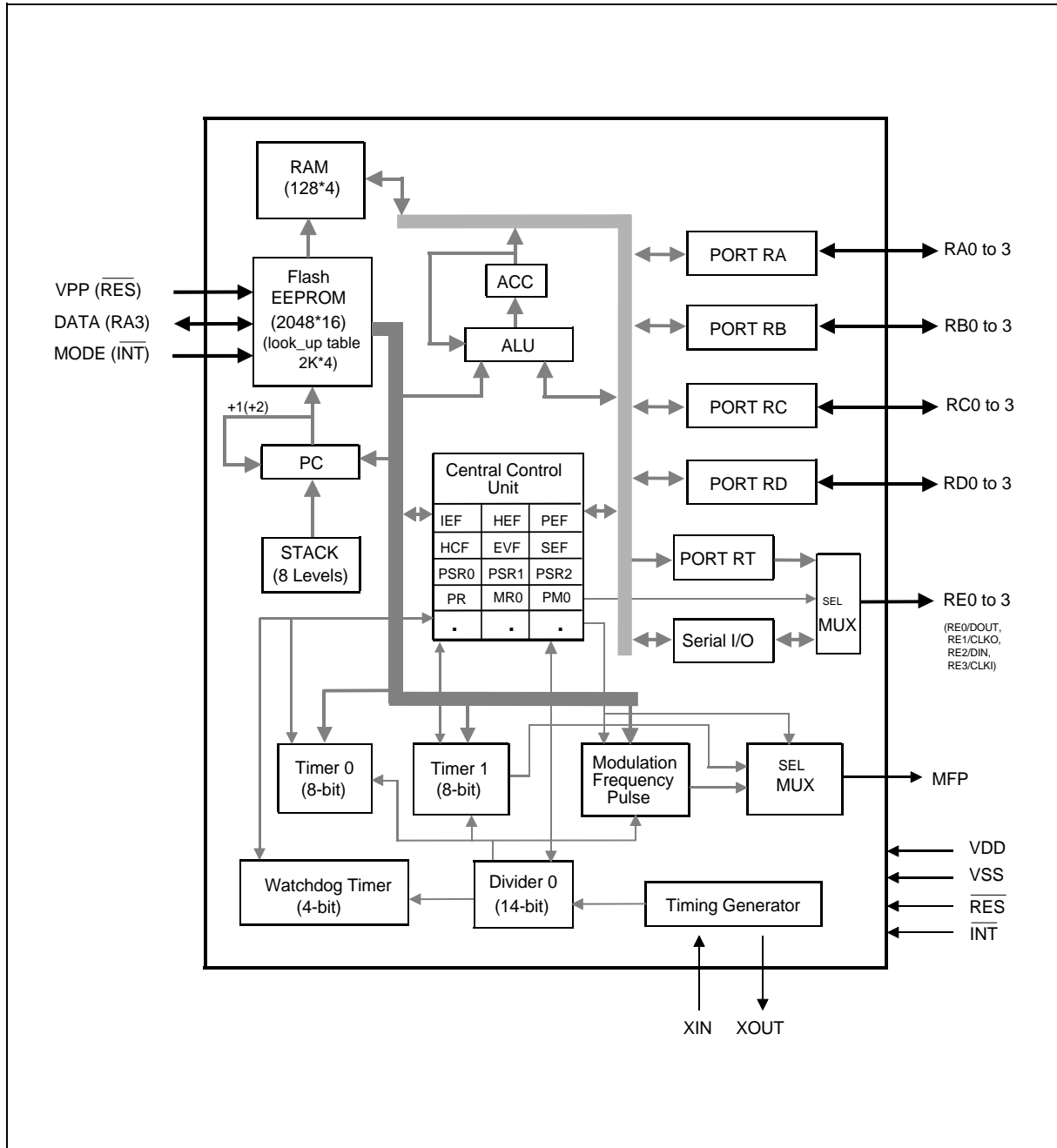


- Timer 1: Offers auto-reload function and one of two internal clock frequencies (F_{OSC} or $F_{OSC}/64$) can be selected or falling edge of pin RC.0 can be selected (output through MFP pin)
- Built-in 18/14-bit watchdog timer selectable for system reset
- Powerful instruction set: 118 instructions
- 8-level subroutine (include interrupt) nesting
- One serial transmission/receiver port specified by software
- Up to 1 μ S instruction cycle (with 4 MHz operating frequency)
- Packaged in 18-pin, 20-pin, 28-pin PDIP and 20-pin, 28-pin SOP

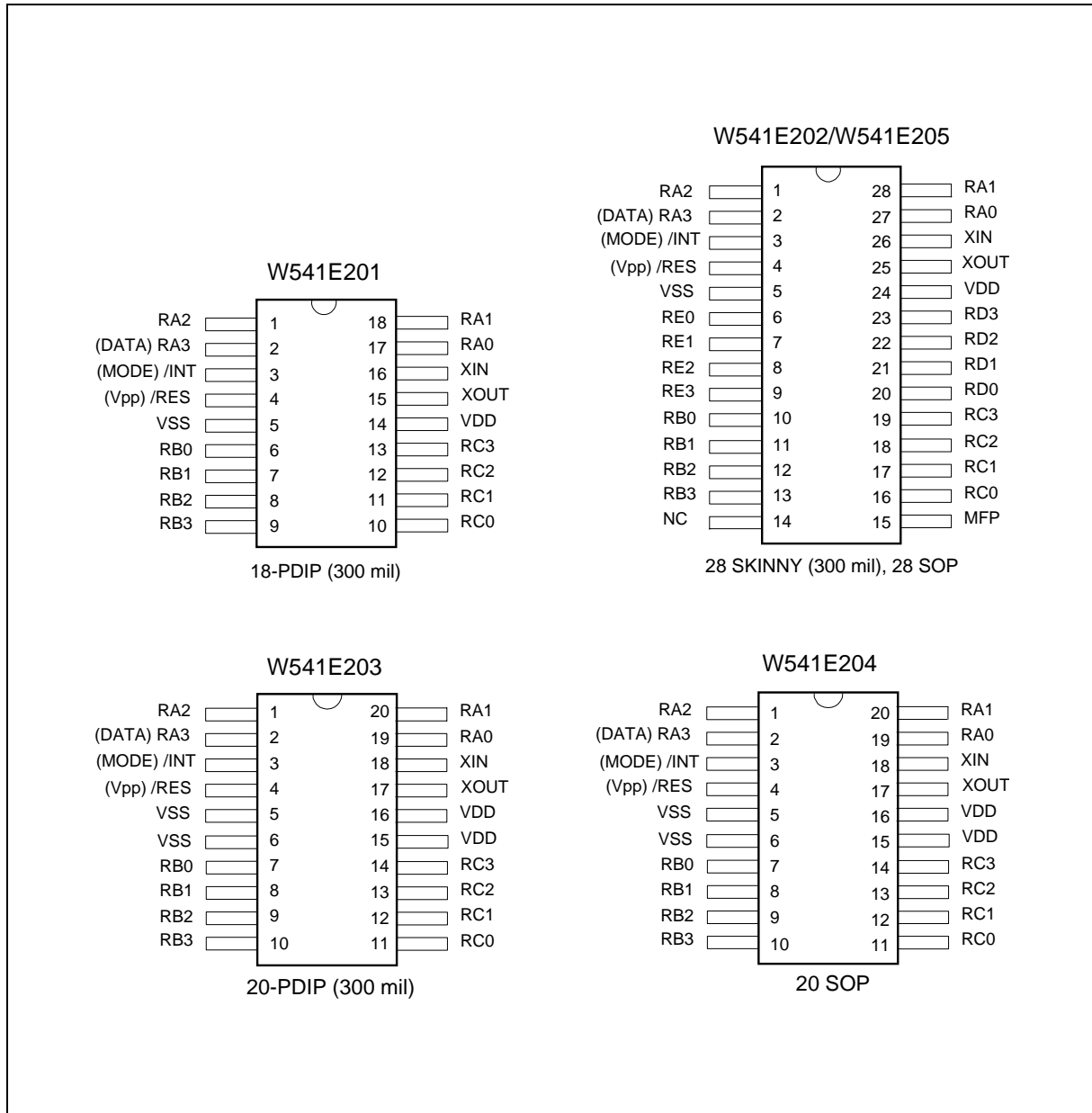
Preliminary W541E20X



BLOCK DIAGRAM



PIN CONFIGURATIONS



Preliminary W541E20X



PIN DESCRIPTION

| SYMBOL | I/O | FUNCTION |
|--|-----|---|
| XIN | 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. |
| XOUT | 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. |
| RA0–RA2, RA3 (DATA) | I/O | Input/Output port. Input/output mode specified by port mode 1 register (PM1). When used as output port, can provide high sink current for driving LED. |
| RB0–RB3 | I/O | Input/Output port. Input/output mode specified by port mode 2 register (PM2). When used as output port, can provide high sink current for driving LED. |
| RC0–RC3 | I/O | Input/Output port. Input/output mode specified by port mode 4 register (PM4). Each pin has an independent interrupt capability in input mode. |
| RD0–RD3 | I/O | Input/Output port. Input/output mode specified by port mode 5 register (PM5). |
| RE0/DOUT, RE1/CLKO, RE2/DIN, RE3/CLKI | I/O | Special input/output port. This port can be configured by software to act as the output of internal port RT or the serial I/O port. When used as output port, can provide high sink current for driving LED. |
| MFP | O | Output pin only. This pin can output modulating or nonmodulating frequency, or Timer 1 clock output specified by mode register 1 (MR1). |
| $\overline{\text{INT}}$ (MODE) ¹ | I | External interrupt pin. This pin must be tied to VDD through an external resistor. It is a low active and floating input pin. |
| $\overline{\text{RES}}$ (VPP) ¹ | I | System reset pin. This pin must be tied to VDD through an external resistor when it is not used to reset this chip. It is a low active and floating input pin. |
| VDD | I | Positive power supply (+). |
| VSS | I | Negative power supply (-). |

Note: There are internal pull-high resistors in these pins of W741C20X.

Preliminary W541E20X



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.

DC CHARACTERISTICS

(VDD-VSS = 3.0 V, Fosc. = 32.768 KHz, Ta = 25° C; unless otherwise specified)

| PARAMETER | SYM. | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------------------------|------|-------------------------------|---------|------|---------|------|
| Op. Voltage | VDD | - | 2.4 | - | 5.5 | V |
| Op. Current (Crystal type) | IOP1 | No load (Ext-V) | - | 8.5 | 20 | μA |
| Op. Current (RC type) | IOP2 | No load (Ext-V) | - | 36 | 65 | μA |
| Hold Current (Crystal type) | IHM1 | Hold mode No load (Ext-V) | - | 4 | 6 | μA |
| Hold Current (RC type) | IHM2 | Hold mode No load (Ext-V) | - | 16 | 40 | μA |
| Stop Current (Crystal type) | ISM1 | Stop mode No load (Ext-V) | - | 0.1 | 2 | μA |
| Stop Current (RC type) | ISM2 | Stop mode No load (Ext-V) | - | 0.1 | 2 | μA |
| Input Low Voltage | VIL | - | VSS | - | 0.3 VDD | V |
| Input High Voltage | VIH | - | 0.7 VDD | - | VDD | V |
| MFP Output Low Voltage | VML | IOL = 3.5mA | - | - | 0.4 | V |
| MFP Output High Voltage | VMH | IOH = -3.5mA | 2.4 | - | - | V |
| Port RA, RB Sink Current | IABL | VOL = 0.9V | 9 | - | - | mA |
| Port RA, RB Source Current | IABH | VOH = 2.4V | 0.4 | 1.2 | - | mA |
| Port RC, RD Output Low Voltage | VCDL | IOL = 2.0 mA | - | - | 0.4 | V |
| Port RC, RD Output High Voltage | VCDH | IOH = -2.0 mA | 2.4 | - | - | V |
| Port RE Sink Current | IEL | VOL = 0.9V | 9 | - | - | mA |
| Port RE Source Current | IEH | VOH = 2.4V | 0.4 | 1.2 | - | mA |
| DIN Pin Pull-up Resistor | RDIN | RE.2 used as serial input pin | 50 | 250 | 1000 | KΩ |

Preliminary W541E20X

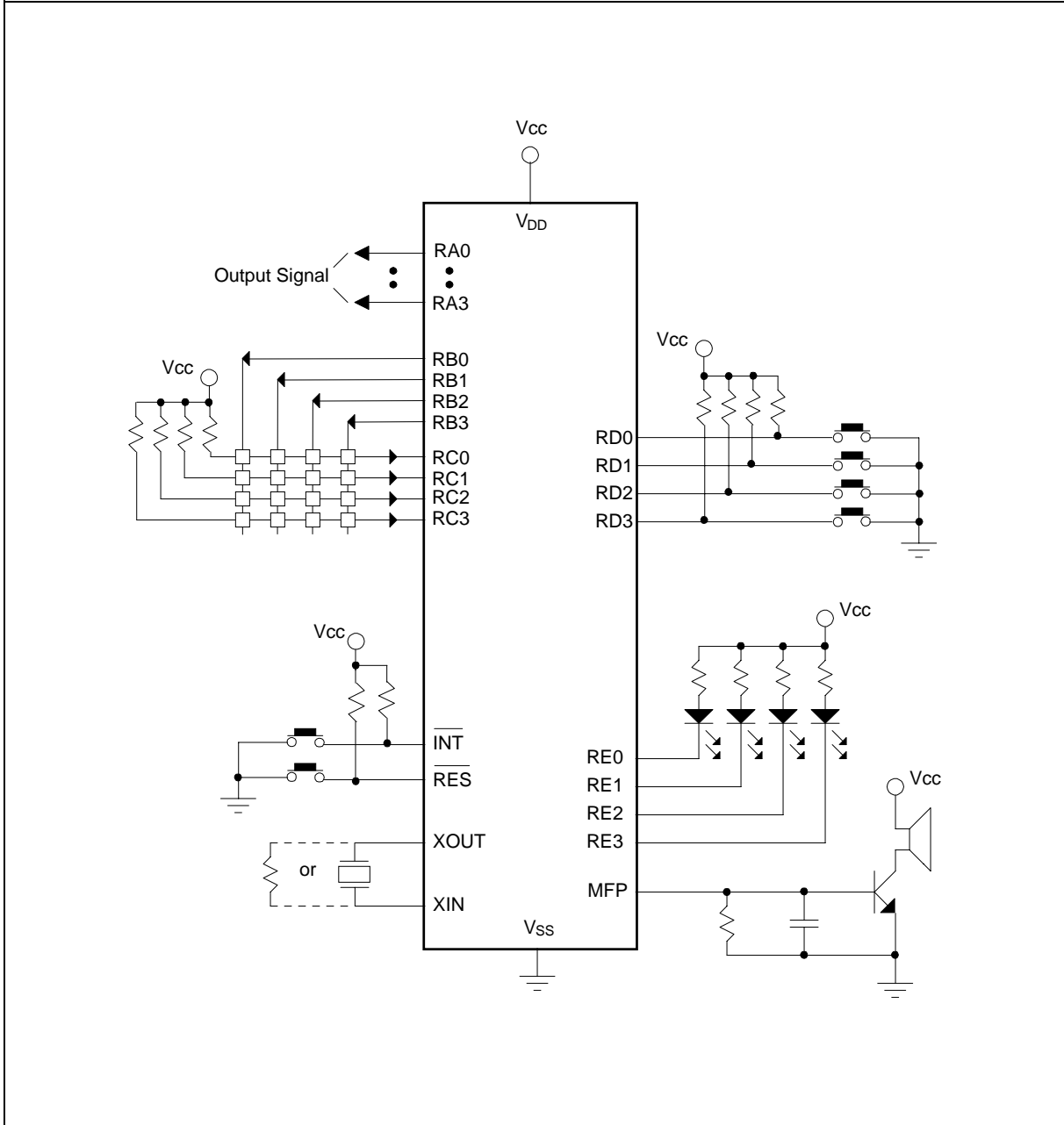


AC CHARACTERISTICS

(VDD-VSS = 3.0 V, Ta = 25° C; unless otherwise specified)

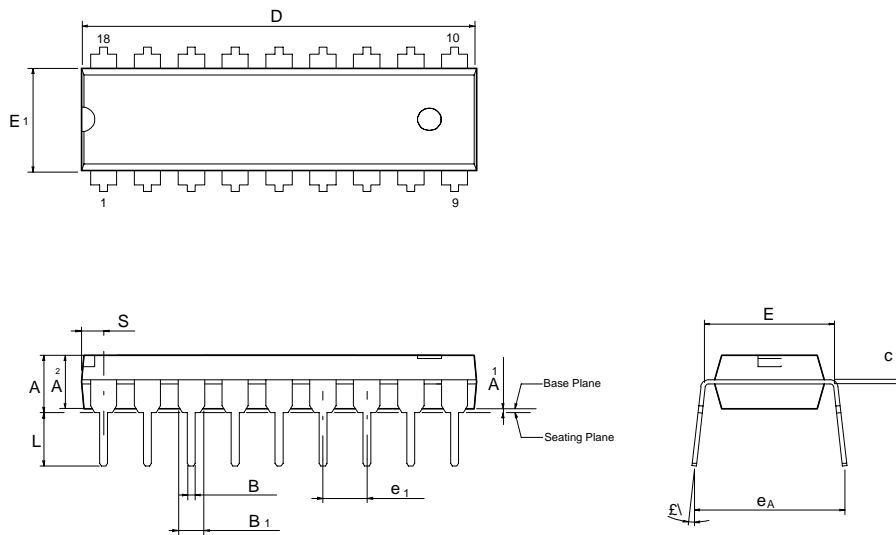
| PARAMETER | SYM. | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|----------------------|--|------|--------|------|------|
| Op. Frequency | Fosc | RC type | - | - | 4000 | KHz |
| | | Crystal type 1 (Option low speed type) | - | 32.768 | - | |
| | | Crystal type 2 (Option high speed type) | 400 | - | 3580 | |
| Frequency Deviation by Voltage Drop for low freq. RC Oscillator | $\frac{\Delta f}{f}$ | $\frac{f(3V) - f(2.4V)}{f(3V)}$ | - | - | 10 | % |
| Instruction Cycle Time | Ti | One machine cycle | - | 4/Fosc | - | S |
| Serial Port Data Ready Time | TDR | - | 200 | - | - | nS |
| Serial Port Data Hold Time | TDH | - | 200 | - | - | nS |
| Reset Active Width | TRAW | Fosc = 32.768 KHz | 1 | - | - | μS |
| Interrupt Active Width | TIAW | Fosc = 32.768 KHz | 1 | - | - | μS |

TYPICAL APPLICATION CIRCUIT



PACKAGE DIMENSIONS

18-Lead PDIP (300 mil)



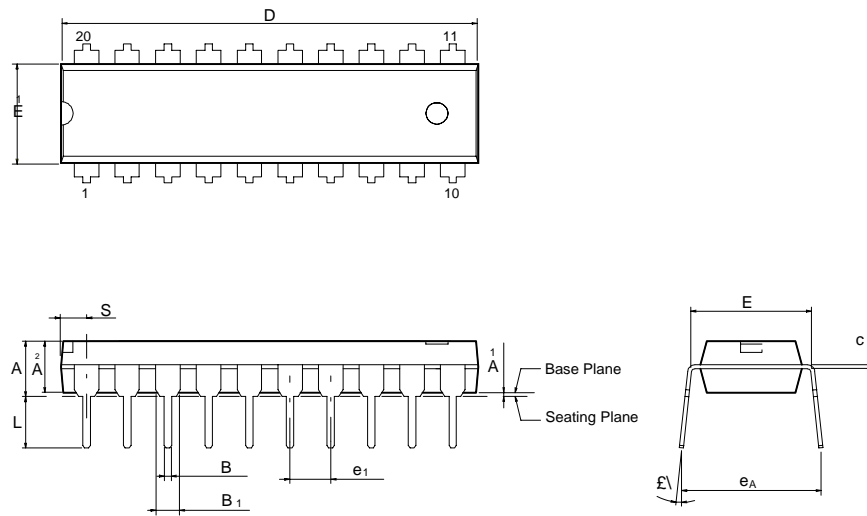
| Symbol | Dimension in inch | | | Dimension in mm | | |
|----------------|-------------------|-------|-------|-----------------|-------|-------|
| | Min. | Nom. | Max | Min | Nom. | Max. |
| A | — | — | 0.175 | — | — | 4.45 |
| A ₁ | 0.010 | — | — | 0.25 | — | — |
| A ₂ | 0.125 | 0.130 | 0.135 | 3.18 | 3.30 | 3.43 |
| B | 0.016 | 0.018 | 0.022 | 0.41 | 0.46 | 0.56 |
| B ₁ | 0.058 | 0.060 | 0.064 | 1.47 | 1.52 | 1.63 |
| c | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D | — | 0.900 | 0.910 | — | 22.86 | 23.11 |
| E | 0.290 | 0.300 | 0.310 | 7.37 | 7.62 | 7.87 |
| E ₁ | 0.245 | 0.250 | 0.255 | 6.22 | 6.35 | 6.48 |
| e ₁ | 0.090 | 0.100 | 0.110 | 2.29 | 2.54 | 2.79 |
| L | 0.120 | 0.130 | 0.140 | 3.05 | 3.30 | 3.56 |
| E\ | 0 | — | 15 | 0 | — | 15 |
| e _A | 0.335 | 0.355 | 0.375 | 8.51 | 9.02 | 9.53 |
| S | — | — | 0.055 | — | — | 1.40 |

Preliminary W541E20X



Package Dimensions, continued

20-Lead PDIP



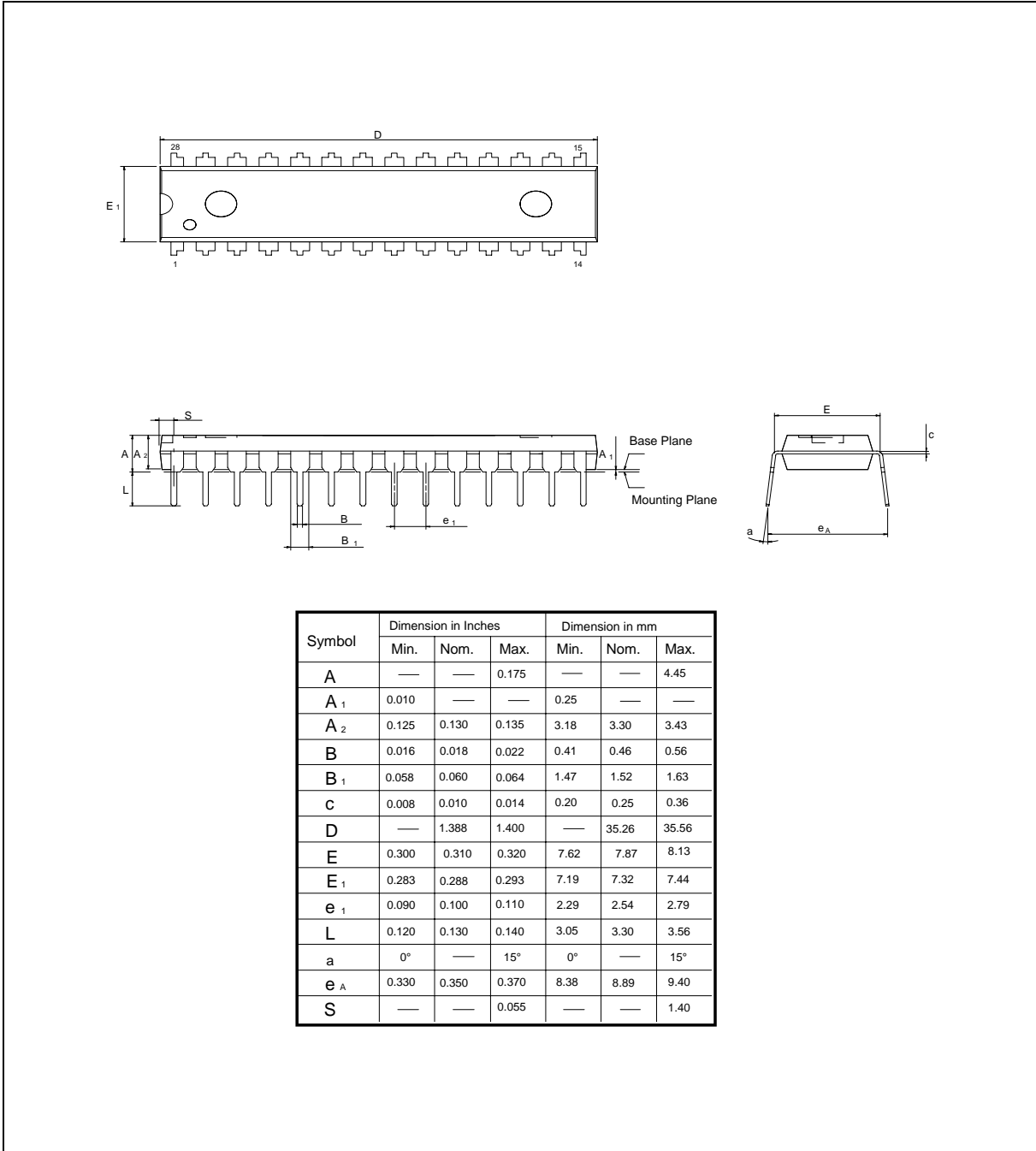
| Symbol | Dimension in inch | | | Dimension in mm | | |
|----------------|-------------------|-------|-------|-----------------|-------|-------|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | — | — | 0.175 | — | — | 4.45 |
| A ₁ | 0.010 | — | — | 0.25 | — | — |
| A ₂ | 0.125 | 0.130 | 0.135 | 3.18 | 3.30 | 3.43 |
| B | 0.016 | 0.018 | 0.022 | 0.41 | 0.46 | 0.56 |
| B ₁ | 0.058 | 0.060 | 0.064 | 1.47 | 1.52 | 1.63 |
| c | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D | — | 1.026 | 1.040 | — | 20.06 | 26.42 |
| E | 0.290 | 0.300 | 0.310 | 7.37 | 7.62 | 7.87 |
| E ₁ | 0.245 | 0.250 | 0.255 | 6.22 | 6.35 | 6.48 |
| e ₁ | 0.090 | 0.100 | 0.110 | 2.29 | 2.54 | 2.79 |
| L | 0.120 | 0.130 | 0.140 | 3.05 | 3.30 | 3.56 |
| £\ | 0 | — | 15 | 0 | — | 15 |
| e _A | 0.335 | 0.355 | 0.375 | 8.51 | 9.02 | 9.53 |
| S | — | — | 0.075 | — | — | 1.91 |

Preliminary W541E20X



Package Dimensions, continued

28-Lead PDIP Skinny



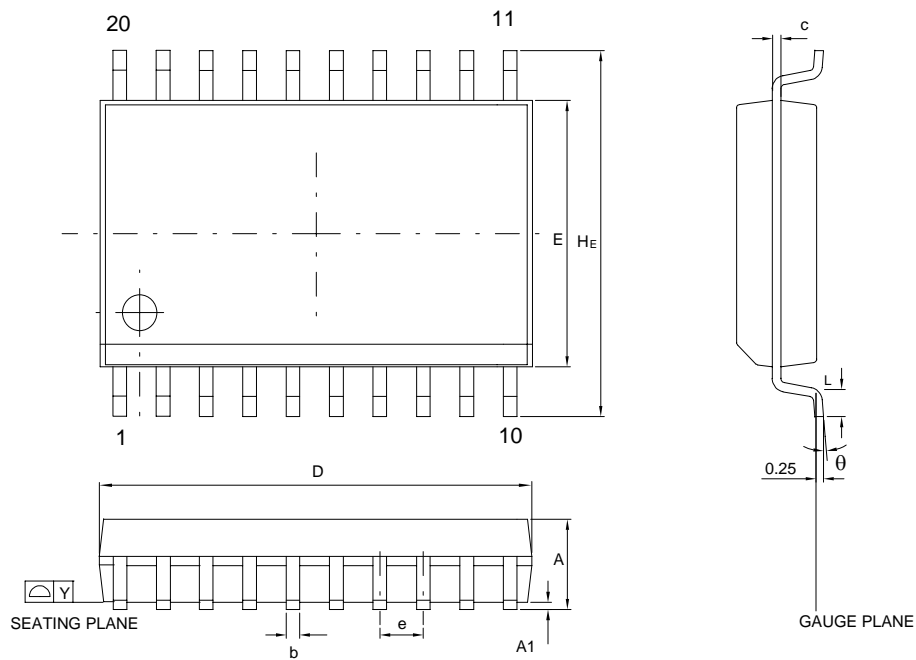
| Symbol | Dimension in Inches | | | Dimension in mm | | |
|----------------|---------------------|-------|-------|-----------------|-------|-------|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | — | — | 0.175 | — | — | 4.45 |
| A ₁ | 0.010 | — | — | 0.25 | — | — |
| A ₂ | 0.125 | 0.130 | 0.135 | 3.18 | 3.30 | 3.43 |
| B | 0.016 | 0.018 | 0.022 | 0.41 | 0.46 | 0.56 |
| B ₁ | 0.058 | 0.060 | 0.064 | 1.47 | 1.52 | 1.63 |
| c | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D | — | 1.388 | 1.400 | — | 35.26 | 35.56 |
| E | 0.300 | 0.310 | 0.320 | 7.62 | 7.87 | 8.13 |
| E ₁ | 0.283 | 0.288 | 0.293 | 7.19 | 7.32 | 7.44 |
| e ₁ | 0.090 | 0.100 | 0.110 | 2.29 | 2.54 | 2.79 |
| L | 0.120 | 0.130 | 0.140 | 3.05 | 3.30 | 3.56 |
| a | 0° | — | 15° | 0° | — | 15° |
| e _A | 0.330 | 0.350 | 0.370 | 8.38 | 8.89 | 9.40 |
| S | — | — | 0.055 | — | — | 1.40 |

Preliminary W541E20X



Package Dimensions, continued

20-Lead SOP (300mil)



Control dimensions are in millimeters.

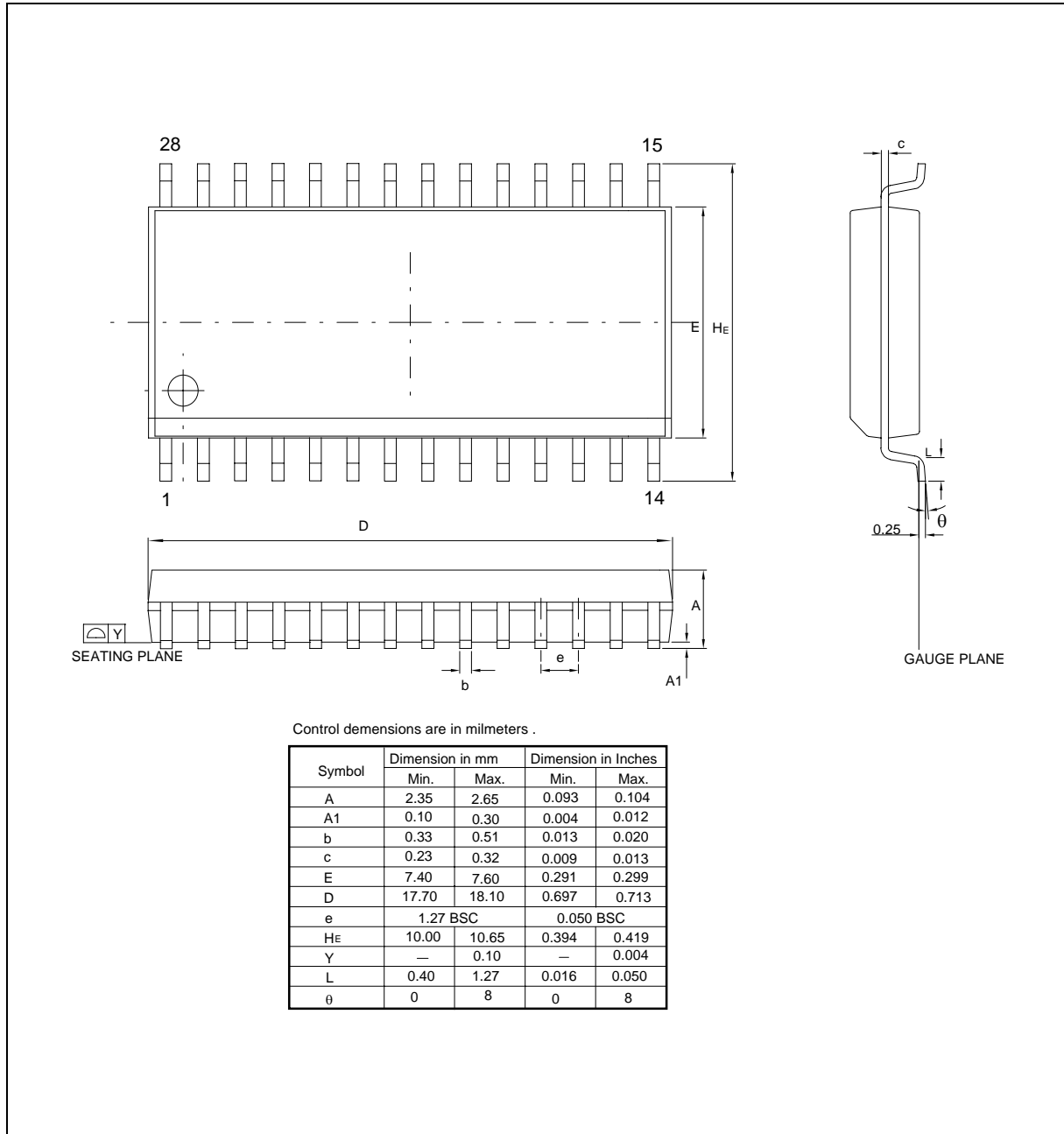
| Symbol | Dimension in mm | | Dimension in Inches | |
|--------|-----------------|-------|---------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 2.35 | 2.65 | 0.093 | 0.104 |
| A1 | 0.10 | 0.30 | 0.004 | 0.012 |
| b | 0.33 | 0.51 | 0.013 | 0.020 |
| c | 0.23 | 0.32 | 0.009 | 0.013 |
| E | 7.40 | 7.60 | 0.291 | 0.299 |
| D | 12.60 | 13.00 | 0.496 | 0.512 |
| e | 1.27 BSC | | 0.050 BSC | |
| He | 10.00 | 10.65 | 0.394 | 0.419 |
| Y | — | 0.10 | — | 0.004 |
| L | 0.40 | 1.27 | 0.016 | 0.050 |
| θ | 0 | 8 | 0 | 8 |

Preliminary W541E20X



Package Dimensions, continued

28-Lead SOP (300 mil)



Publication Release Date: June 2003
Revision A2

Preliminary W541E20X



Notes:



Headquarters

No. 4, Creation Rd. III,
Science-Based Industrial Park,
Hsinchu, Taiwan
TEL: 886-3-5770066
FAX: 886-3-5792766
<http://www.winbond.com.tw/>
Voice & Fax-on-demand: 886-2-27197006

Taipei Office

11F, No. 115, Sec. 3, Min-Sheng East Rd.,
Taipei, Taiwan
TEL: 886-2-27190505
FAX: 886-2-27197502

Winbond Electronics (H.K.) Ltd.

Rm. 803, World Trade Square, Tower II,
123 Hoi Bun Rd., Kwun Tong,
Kowloon, Hong Kong
TEL: 852-27513100
FAX: 852-27552064

Winbond Electronics North America Corp.

Winbond Memory Lab.
Winbond Microelectronics Corp.
Winbond Systems Lab.
2727 N. First Street, San Jose,
CA 95134, U.S.A.
TEL: 408-9436666
FAX: 408-5441798

Note: All data and specifications are subject to change without notice.