

4-BIT MICROCONTROLLER

1. GENERAL DESCRIPTION

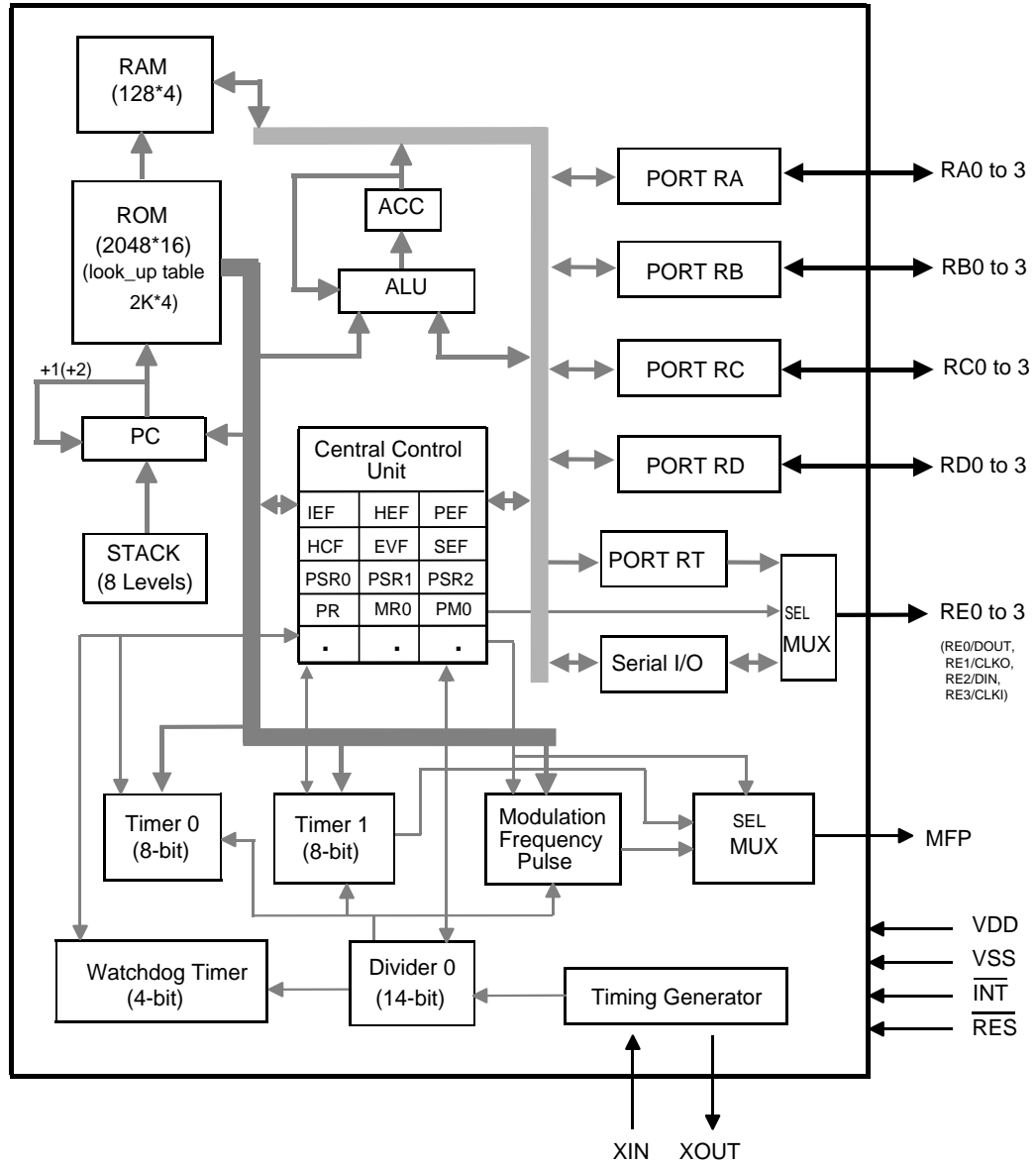
The W541L20X is a high-performance 4-bit microcontroller (μ C) that operates on very low current. The device contains a 4-bit ALU, two 8-bit timers, a divider, a serial port, and five 4-bit I/O ports (including 3 output ports for LED driving). There are also seven interrupt sources and 8-level subroutine nesting for interrupt applications. The W541L20X has two power reduction modes, hold mode and stop mode, which help to minimize power dissipation.

The W541L20X is suitable for remote controllers, toy controllers, keyboard controllers, speech synthesis LSI controllers, and other products.

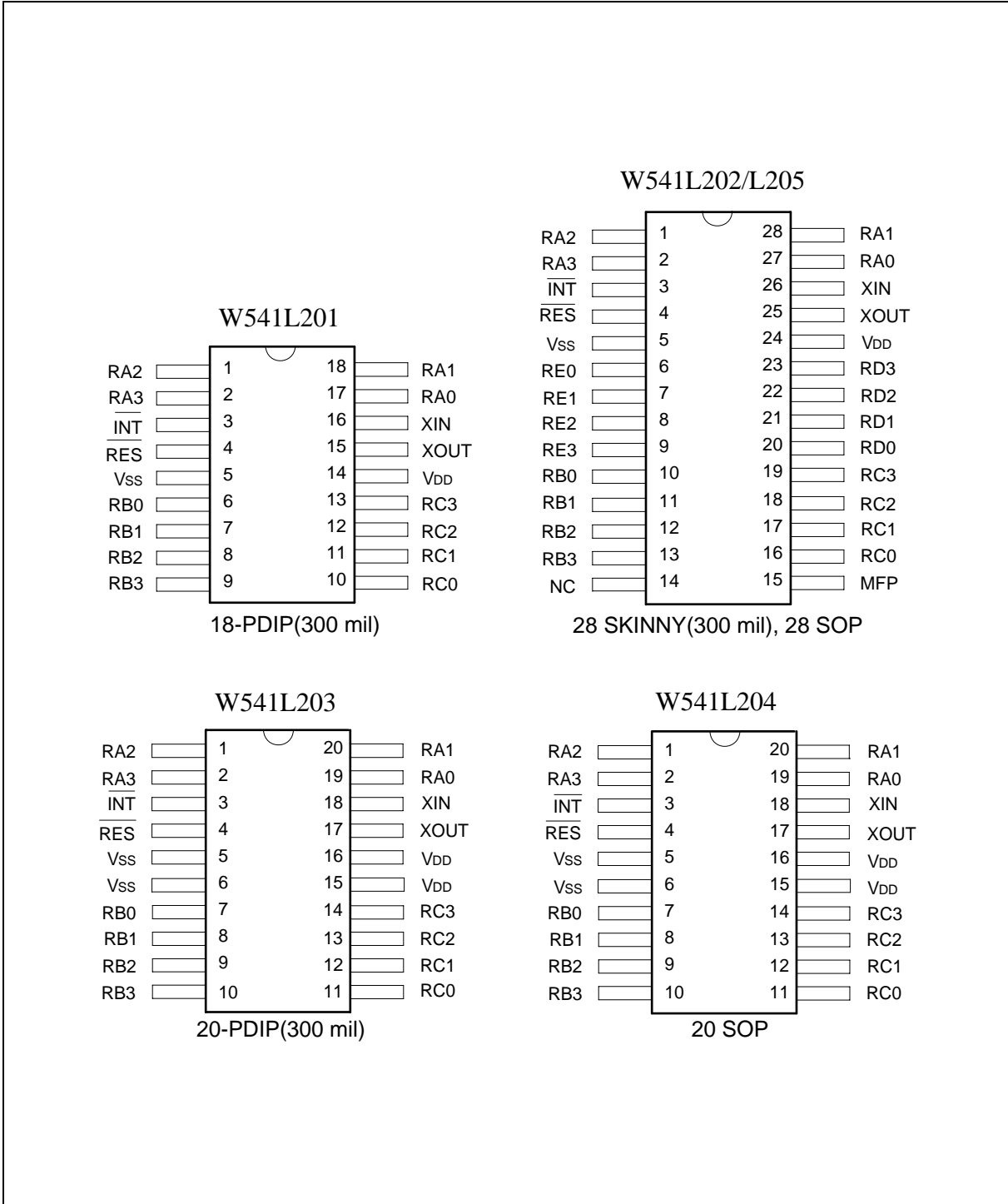
2. FEATURES

- Operating voltage: 1.2V to 1.8V
- Single system clock
 - Oscillation frequency up to 1 MHz, Crystal or RC oscillator is selected by mask code option,
 - High-frequency (400 KHz to 1 MHz) or low-frequency (32.768 KHz) oscillation is selected by mask code option
- Memory
 - 2048 x 16 bit program ROM (including 2K x 4 bit look-up table)
 - 128 x 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 out pin: 1pin (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 (FOSC/4 or FOSC/1024) can be selected
 - Timer 1: Offers auto-reload function, and one of two internal clock frequencies (FOSC or FOSC/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 4 μ S instruction cycle (with 1 MHz operating frequency)
- Packaged in 18-pin, 20-pin, 28-pin PDIP and 20-pin, 28-pin SOP

3. BLOCK DIAGRAM



4. PIN CONFIGURATIONS



5. 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~RA3	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. And build-in schmitt trigger
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).
$\overline{\text{INT}}$	I	External interrupt pin with pull-high resistor.
$\overline{\text{RES}}$	I	System reset pin with pull-high resistor.
V _{DD}	I	Positive power supply (+).
V _{SS}	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

($V_{DD}-V_{SS} = 1.5V$, $F_{osc} = 32.768\text{ KHz}$, $T_a = 25^\circ\text{ C}$; unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Op. Voltage (Crystal type)	VDD1	High-frequency Oscillation	1.35	-	1.8	V
Op. Voltage (RC type)	VDD2	High-frequency Oscillation	1.2	-	1.8	V
Op. Voltage (RC,Crystal)	VDD3	Low-frequency Oscillation	1.2	-	1.8	V
Op. Current (Crystal type)	IOP1	No load (Ext-V)	-	4	12	μA
Op. Current (RC type)	IOP2	No load (Ext-V)	-	35	65	μA
Hold Current (Crystal type)	IHM1	Hold mode No load (Ext-V)	-	3	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 = 0.9 mA	-	0.1	0.3	V

6.2 DC Characteristics, continued

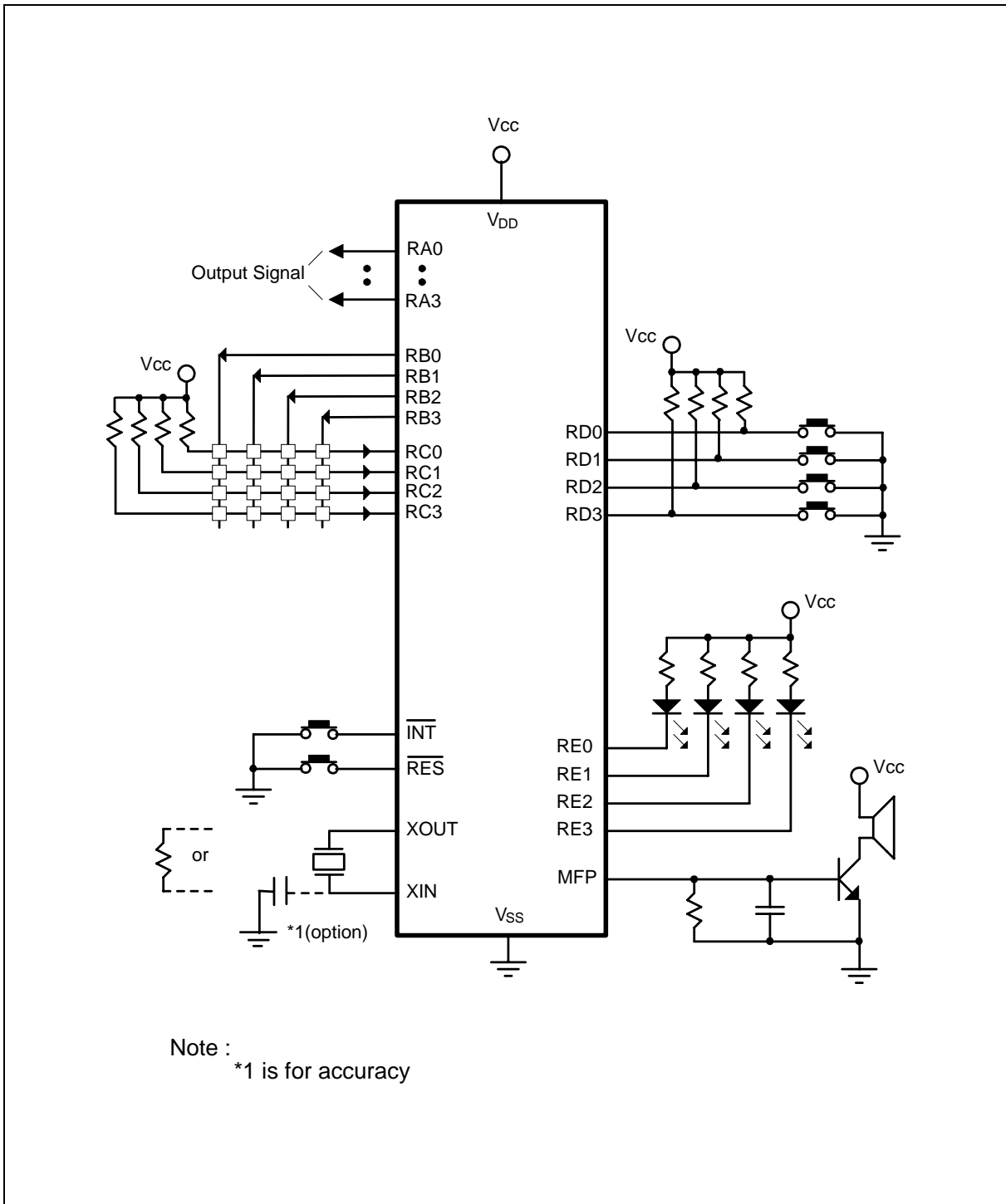
PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
MFP Output High Voltage	VMH	IOH = -0.75 mA	1.2	1.4	-	V
Port RA, RB Output Low Voltage	VABL	IOL = 1.0 mA	-	0.2	0.3	V
Port RA, RB Output High Voltage	VABH	IOH = 0.5 mA	1.2	1.4	-	V
Port RC, RD Output Low Voltage	VCDL	IOL = 1.0 mA	-	0.2	0.3	V
Port RC, RD Output High Voltage	VCDH	IOH = -0.5 mA	1.2	1.4	-	V
Port RE Sink Current	IEL	VOL = 0.3V	2	-	-	mA
Port RE Source Current	IEH	VOH = 1.2V	0.35	0.45	-	mA
$\overline{\text{INT}}$ Pull-up Resistor	RINT	-	100	250	500	K Ω
DIN Pin Pull-up Resistor	RDIN	RE.2 used as serial input pin	100	250	500	K Ω
$\overline{\text{RES}}$ Pull-up Resistor	RRES	-	100	250	500	K Ω

6.3 AC Characteristics

(V_{DD}-V_{SS} = 1.5 V, Ta = 25° C; unless otherwise specified)

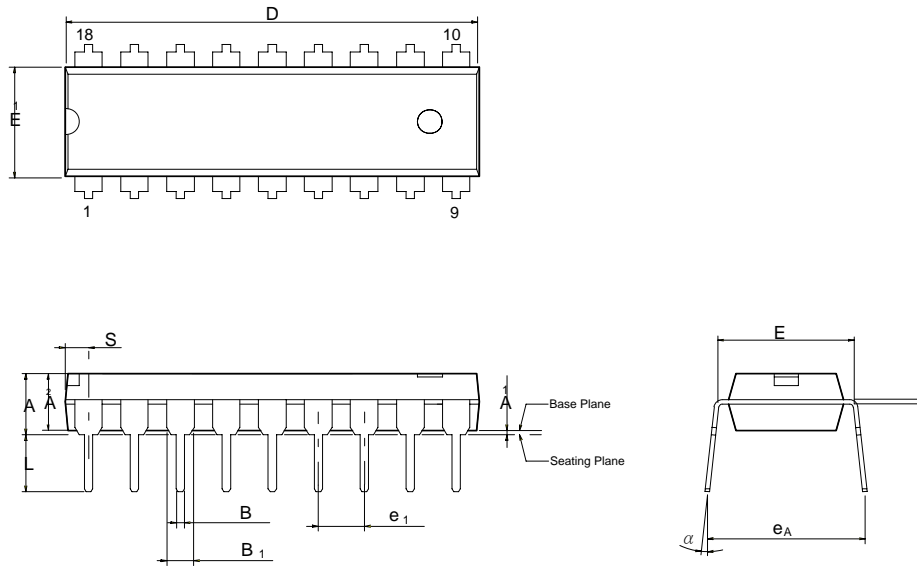
PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Op. Frequency	FOSC	RC type	-	-	1000	KHz
		Crystal type 1 (Option low speed type)	-	32.768	-	
Instruction Cycle Time	T _I	One machine cycle	-	4/FOSC	-	mS
Serial Port Data Ready Time	TDR	-	200	-	-	nS
Serial Port Data Hold Time	TDH	-	200	-	-	nS
Reset Active Width	T _{RAW}	FOSC = 32.768 KHz	1	-	-	μ S
Interrupt Active Width	T _{IAW}	FOSC = 32.768 KHz	1	-	-	μ S

7. APPLICATION CIRCUIT



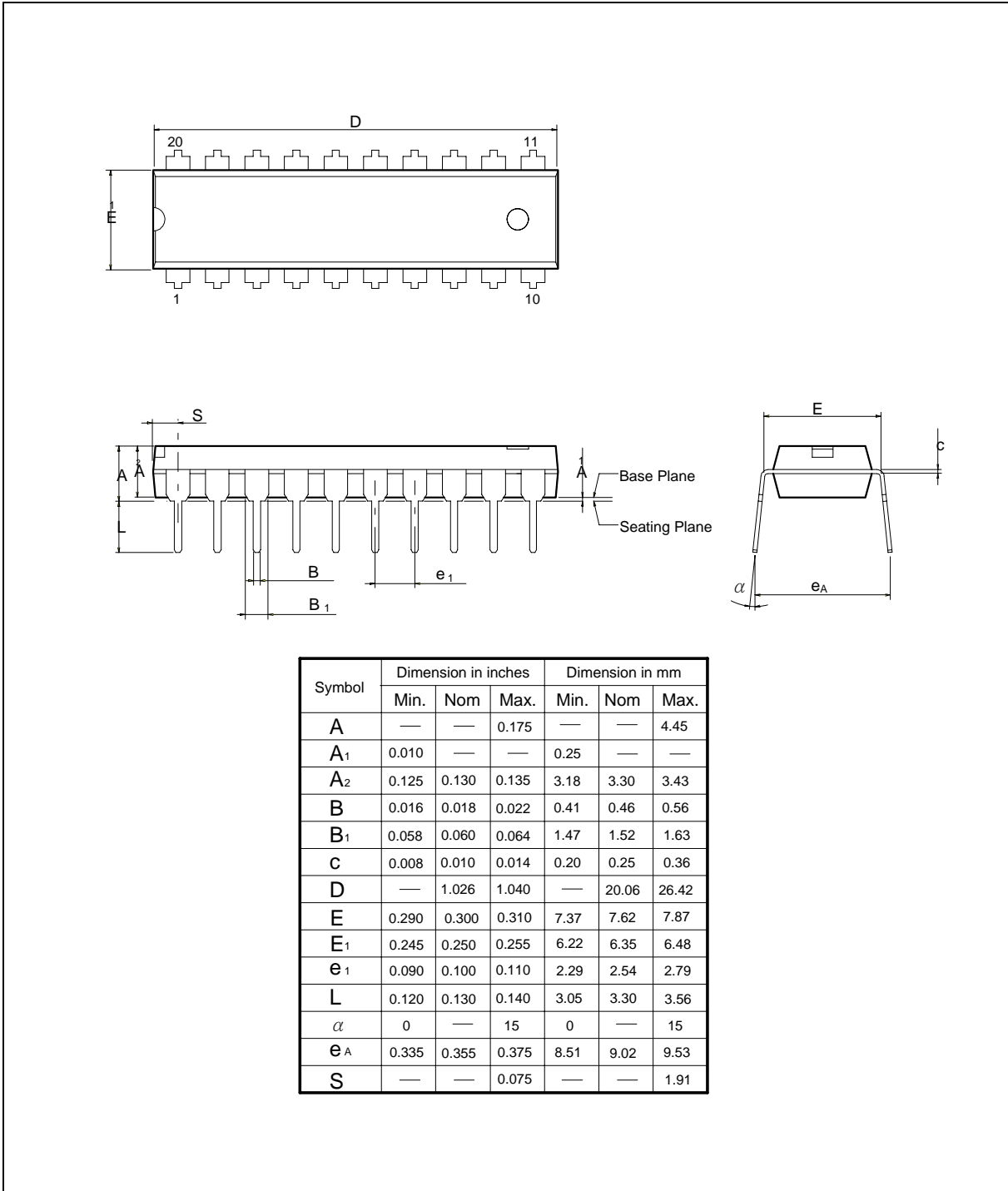
8. PACKAGE DIMENSIONS

8.1 18-Lead PDIP-300mil

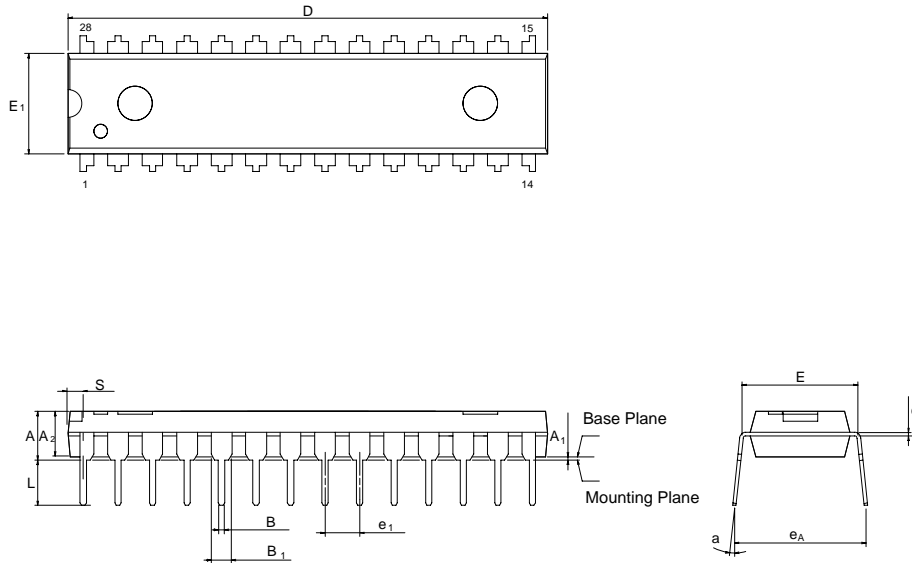


Symbol	Dimension in inches			Dimension in mm		
	Min.	Nom	Max.	Min.	Nom	Max.
A	—	—	0.175	—	—	4.45
A ₁	0.010	—	—	0.25	—	—
A ₂	0.125	0.130	0.135	3.18	3.30	3.43
B	0.016	0.018	0.022	0.41	0.46	0.56
B ₁	0.058	0.060	0.064	1.47	1.52	1.63
C	0.008	0.010	0.014	0.20	0.25	0.36
D	—	0.900	0.910	—	22.86	23.11
E	0.290	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
α	0	—	15	0	—	15
e _A	0.335	0.355	0.375	8.51	9.02	9.53
S	—	—	0.055	—	—	1.40

8.2 20-Lead PDIP

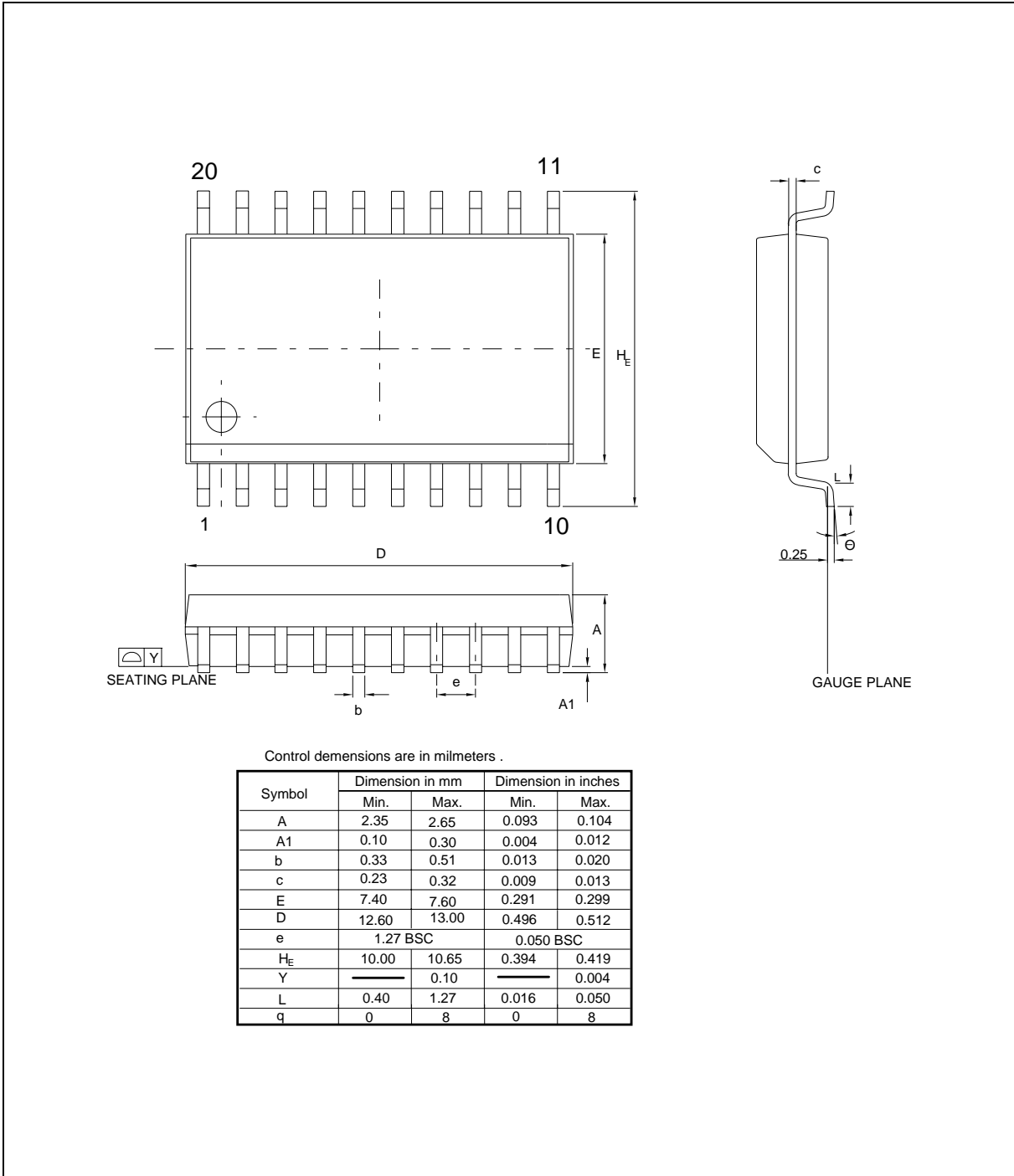


28-Lead PDIP Skinny

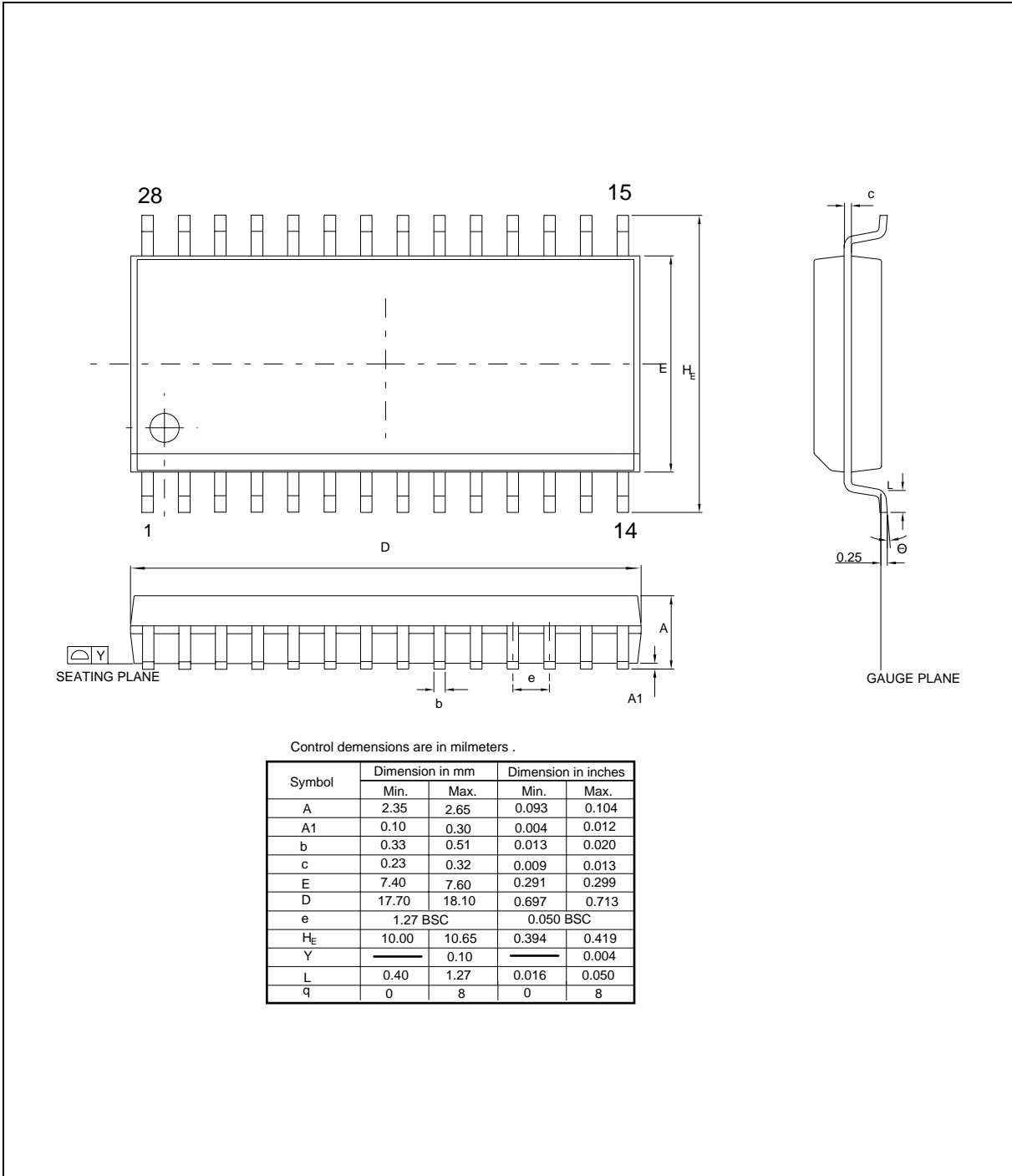


Symbol	Dimension in Inches			Dimension in mm		
	Min.	Nom	Max.	Min.	Nom	Max.
A	—	—	0.175	—	—	4.45
A ₁	0.010	—	—	0.25	—	—
A ₂	0.125	0.130	0.135	3.18	3.30	3.43
B	0.016	0.018	0.022	0.41	0.46	0.56
B ₁	0.058	0.060	0.064	1.47	1.52	1.63
c	0.008	0.010	0.014	0.20	0.25	0.36
D	—	1.388	1.400	—	35.26	35.56
E	0.300	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

20-Lead SOP-300mil



28-Lead SOP-300mil



9. REVISION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A2	-	-	Note : Recommend working voltage range for Hi freq all mode (L series)
A3	-	-	Note: RC is built-in schmitt trigger
A4	June 3, 2003	-	Note: Do not be floating when it is as input or output open-drain (NMOS type)
A5	June 23, 2005	-	Note: Add Important Notice
A6	June 30, 2008	-	Note: Logo change
A6.1	November 06, 2009	1	Release day data mistake

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