佑 華 微 電 子 股 份 有 限 公 司

AM4EA_OTP Series

DATA SHEET

佑華微電子股份有限公司

新竹市光復路二段 295 號 9 樓之 1 號

電話: 03-573 6660

傳真: 03-573 6661

www.ealpha.com.tw

Alpha Microelectronics Corp.

9F-1, 295, Sec. 2, Kuang Fu Rd., Hsinchu, Taiwan

Tel : +886-3-573 6660

Fax: +886-3-573 6661

www.ealpha.com.tw

Rev 1.20 2007/12/10

Revision History

Revision	Date	Description	Page
1.00	2006/9/18	Original	-
1.01	2006/10/20	Modify Application circuit	8
1.10	2006/12/27	Add AM4EA170A description & Modify Reset circuit	2-5,7,9,10,12,14
1.20	2007/12/10	Add AM4EA015A description	2-4,6,7,10,13,16,17,19

Table of Contents

1. General Description

The AM4EA_OTP series are very low cost voice and melody synthesizer with 4-bit CPU. They have various features including 4-bit ALU, EPROM, RAM, I/O ports, timers, clock generator, voice and melody synthesizer, and PWM (Direct drive) or D/A current outputs, etc. The audio synthesizer contains one voice-channel and two melody-channels. Furthermore, they consist of 27 instructions in these devices. With CMOS technology and halt function can minimize power dissipation. Their architectures are similar to RISC, with two stages of instruction pipeline. They allow all instructions to be executed in a single cycle, except for program branches and data table read instructions (which need two instruction cycles).

2. Features

(1) Single power supply can operate from 2.2~5.5V at 4MHz or 3.6~5.5V at 8MHz.

(2) Program ROM: AM4EA015A /AM4EA031A is 16k x 10 bits; AM4EA084A/AM4EA170A is 64k x 10 bits.

(3) 1 set of 16-bit DPR can access up to 64k x 10 bits melody data memory space, and 1 set of 18-bit VPR can access up to 256k x 10 bits voice data memory space. And 1 set of 19bit VPR can access up to 512 x10 bit voice data memory space.

Product	Voice Duration (sec)	Voice Pointer (VPR)	ROM Size (10-bit)
AM4EA015A	15	16-bit	48k
AM4EA031A	31	17-bit	96k
AM4EA084A	84	18-bit	256k
AM4EA170A	170	19-bit	512k

(4) Data Registers:

a) 128 x 4-bit data RAM (00-7Fh).

b) Unbanked special function registers (SFR) range: 00h-2Fh.

(5) I/O Ports:

Product	I/O	Port name
AM4EA015A	8	PRA~PRB
AM4EA031A	16	PRA~PRD
AM4EA084A	16	PRA~PRD
AM4EA170A	24	PRA~PRF

a) PRA: 4-bit I/O Port A (10h) can be programmed to input/output individually. (Register control)

b) PRB: 4-bit I/O Port B (13h) can be configured to input/output individually. (Code option)

c) PRC: 4-bit I/O Port C (14h) can be programmed to input/output individually. (Register control)

d) PRD: 4-bit I/O Port D (15h) can be programmed to input/output individually. (Register control)

e) PRE: 4-bit I/O Port E (17h) can be programmed to input/output individually. (Register control)

f) PRF: 4-bit I/O Port F (18h) can be programmed to input/output individually. (Register control)

(6) On-chip clock generator: Resistive Clock Drive ***(RM)*** or Crystal oscillator ***(HM)***.

(7) Timer: 1-set Voice Interrupt (Timer0: a 9-bit auto-reload timer/counter).

(8) Stack: 2-level subroutine nesting.

(9) Built-in 4-level Volume Control can be programmed.

(10) Built-in 8-level DAC current output can be configured. (Code option)

(11) Built-in IR Carrier Output: Port B[1] can be configured as IR pin by 38k / 56kHz. (Code option)

(12) External Reset: Port B[3] can be configured as reset pin. (Code option)

(13) HALT and Release from HALT function to reduce power consumption.

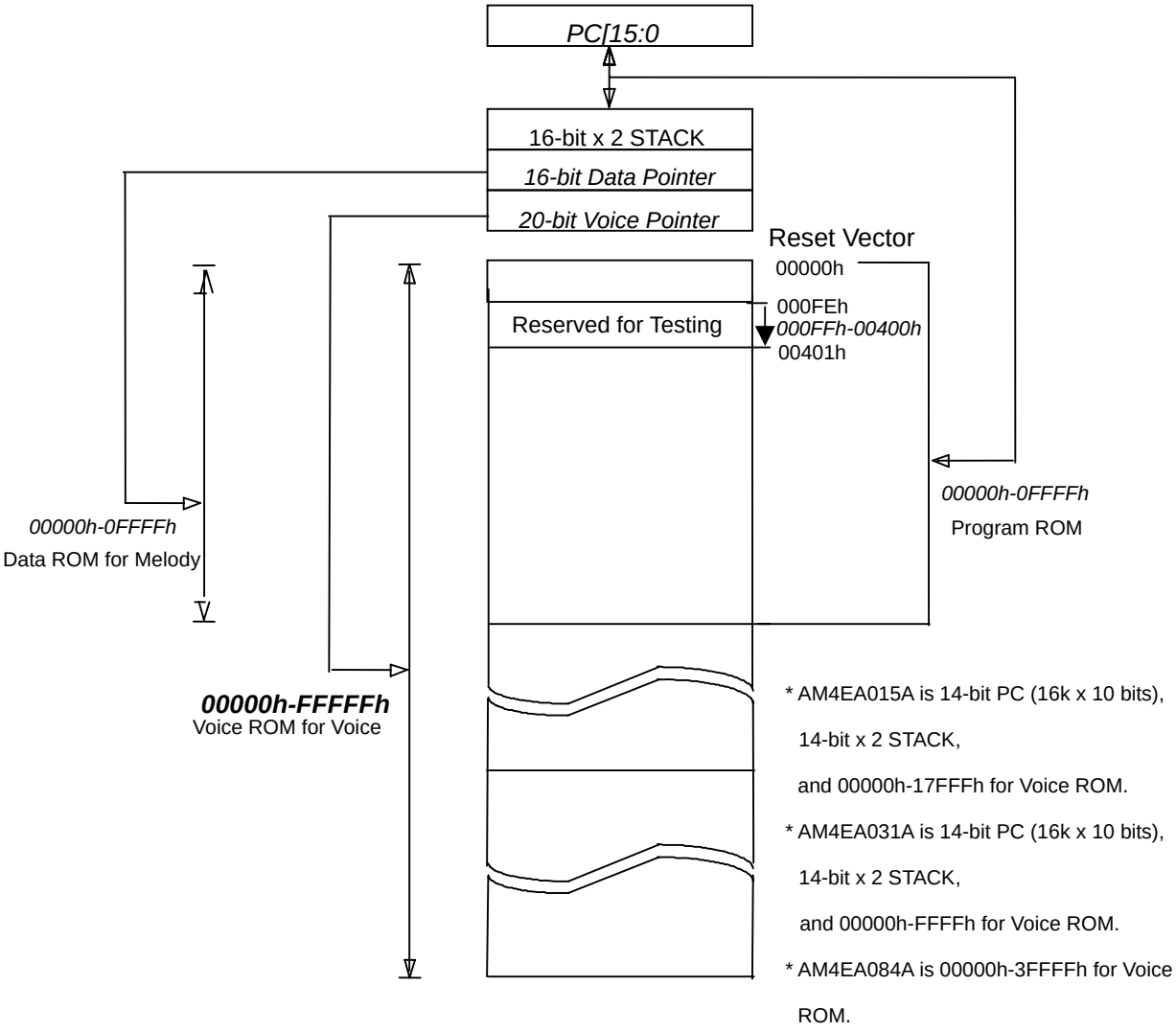
(14) Watch Dog Timer (***WDT***)

(15) Instruction: 1-cycle instruction except for table read and program branches which are 2-cycles.

(16) Number of instruction: 27.

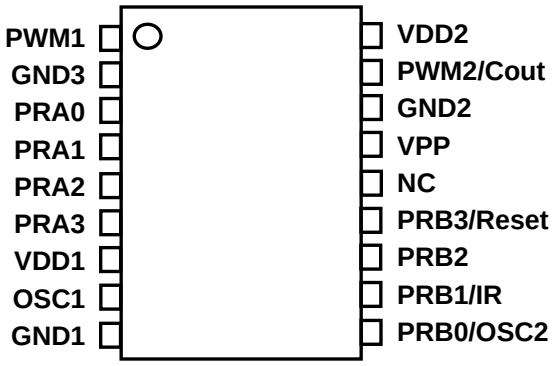
(17) DAC: 1 channel voice and dual tone melody synthesizer (One 9-bit Cout or 8-bit PWM output).

FIGURE 1: ROM Map of AM4EA170A



3. Pin Assignment (AM4EA015A)

18Pin Skinny DIP 300mil & SOP 300mil

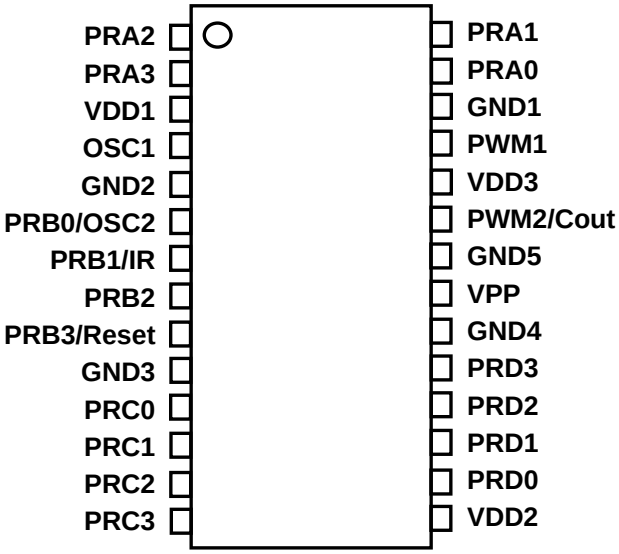


Pin Description

Pad Name	Pin Attr.	Description
PWM2/Cout	O	PWM2 output, or Current Output of Audio.
PWM1	O	PWM1 output.
Vdd1~2	Power	Power supply during operation.
PRA0~3	I/O	I/O port can be programmed to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB0 / OSC2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. HM mode Crystal input.
PRB1 / IR	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Code option selected as an IR Carrier Output with 38k / 56kHz*
PRB2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB3 / Reset	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Code option selected as an external RESET pin with weak pull-low*
OSC1	I	RM mode Oscillator input. HM mode Crystal input.
GND1~3	Power	Ground Potential
VPP	Power	Connect to VDD during normal operation. Connect to High Voltage when programming EPROM.

4. Pin Assignment (AM4EA031A/AM4EA084A)

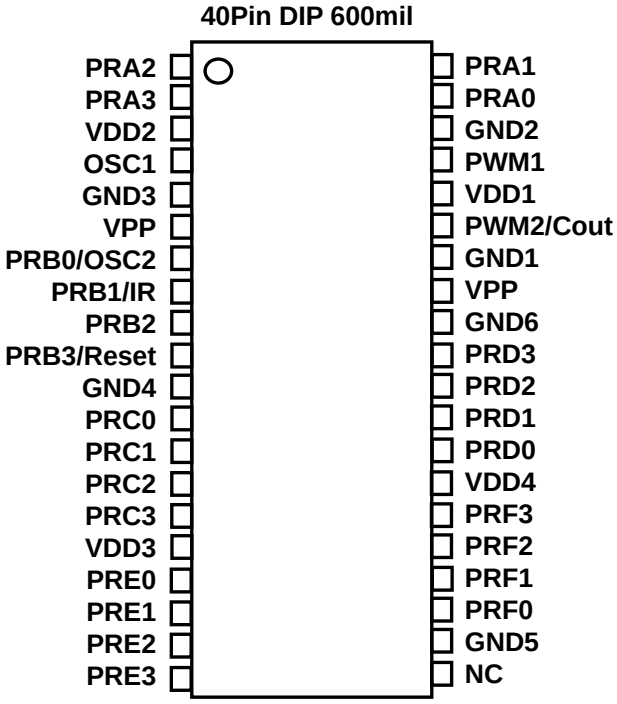
28Pin Skinny DIP 300mil & SOP 300mil



Pin Description

Pad Name	Pin Attr.	Description
PWM2/Cout	O	PWM2 output, or Current Output of Audio.
PWM1	O	PWM1 output.
Vdd1~3	Power	Power supply during operation.
PRA0~3 **PRC0~3** **PRD0~3**	I/O	I/O port can be programmed to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB0 / OSC2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. HM mode Crystal input.
PRB1 / IR	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Code option selected as an IR Carrier Output with 38k / 56kHz*
PRB2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB3 / Reset	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Code option selected as an external RESET pin with weak pull-low*
OSC1	I	RM mode Oscillator input. HM mode Crystal input.
GND1~5	Power	Ground Potential
VPP	Power	Connect to VDD during normal operation. Connect to High Voltage when programming EPROM.

5. Pin Assignment (AM4EA170A)



Pin Description

Pad Name	Pin Attr.	Description
PWM2/Cout	O	PWM2 output, or Current Output of Audio.
PWM1	O	PWM1 output.
VDD1~4	Power	Power supply during operation.
PRA0~3 **PRC0~3** **PRD0~3** **PRE0~3** **PRF0~3**	I/O	I/O port can be programmed to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB0 / OSC2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. HM mode Crystal input.
PRB1 / IR	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Code option selected as an IR Carrier Output with 38k / 56kHz*
PRB2	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type.
PRB3 / Reset	I/O	I/O port can be configured to input/output individually. Input type with weak pull-low or fix-input-floating capability. Buffer Output type. *Code option selected as an external RESET pin with weak pull-low*
OSC1	I	RM mode Oscillator input. HM mode Crystal input.
GND1~6	Power	Ground Potential
VPP	Power	Connect to VDD during normal operation. Connect to High Voltage when programming EPROM.

6. Absolute Maximum Rating

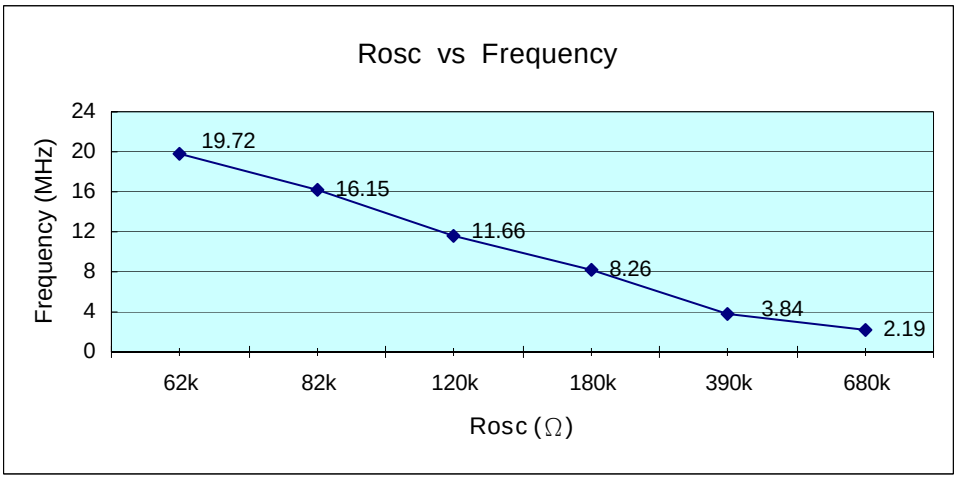
Symbol	Rating	Unit
V_{dd}~V_{ss}	-0.5 ~ +7.0	V
V_{pp}~V_{ss}	-0.5 ~ +12.5	V
V_{in}	V_{ss}-0.3 < V_{in} < V_{dd}+0.3	V
V_{out}	GND < V_{out} < V_{dd}	V
T_{op} (operating)	0 ~ +70	°C
T_{st} (storage)	-25 ~ +85	°C

7. DC Characteristics

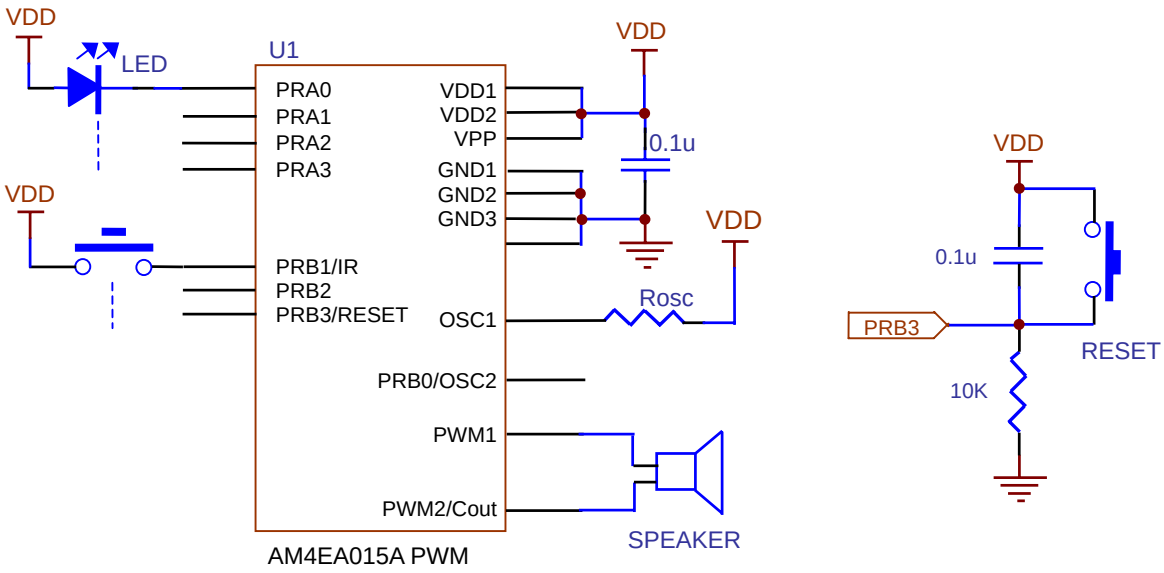
Symbol	Parameter		Vdd	Min.	Typ.	Max.	Unit	Condition
V_{dd}	Operating voltage			2.2	3	5.5	V	F_{osc}=4MHz
I_{sb}	Supply current	Standby	3			1	uA	4MHz, RM, HALT Mode
			4.5			1		
I_{op}		Operating	3		1		mA	4MHz, RM, no load
			4.5		2.5			
I_{ih}	Input current (Internal pull low)		3		5		uA	Input ports with weak pull-low
			4.5		12			
I_{oh}	Output-high current		3		-3.5		mA	V_{oh}=2.6V
			4.5		-7.5			V_{oh}=3.7V
I_{ol}	Output-low current		3		3.92		mA	V_{ol}=0.4V
			4.5		9.43			V_{ol}=0.8V
I_{oh}	PWM output current		3		-25		mA	V_{dd}=3V, V_{oh}=2.4V
I_{ol}			3		25			V_{dd}=3V, V_{ol}=0.6V
C_{out}	DAC output current (8-level option)		3	0.8 ~ 5.8			mA	4MHz, RM (Full scale)
			4.5	0.9 ~ 6.5				
dF/F	Frequency stability			-5		5	dF/F	$\frac{F_{osc}(3v-2.4v)}{F_{osc}(3v)}$
dF/F	F_{osc} lot variation			-10		10	dF/F	V_{dd}=3V, R_{osc}=390k, (~4MHz)

FIGURE 2: Frequency vs. Rosc (at 3V)

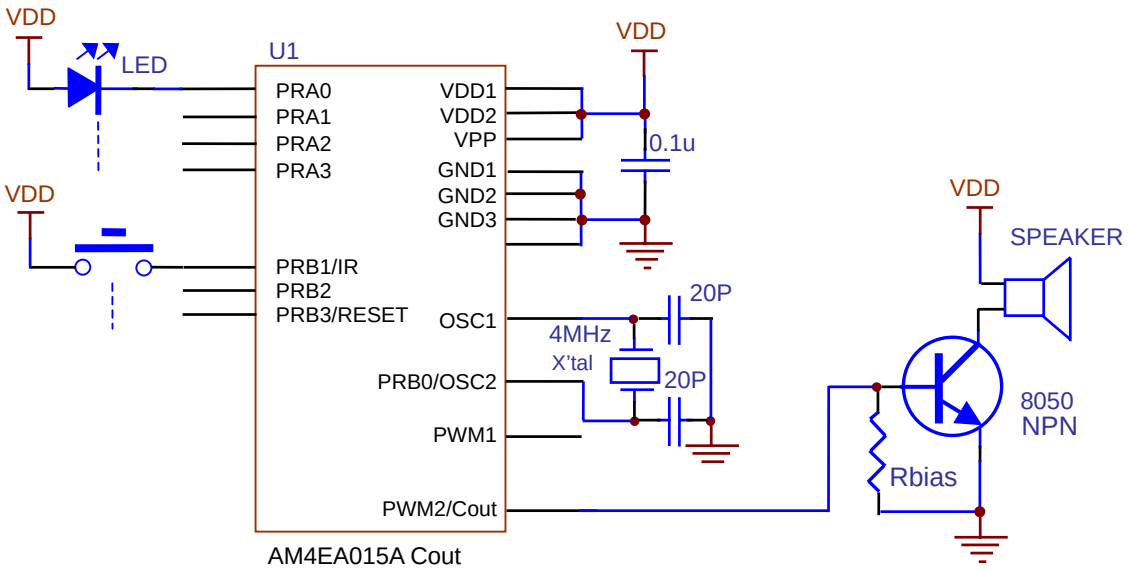
Resistor (Rosc ohms)	62k	82k	120k	180k	390k	680k
Frequency (MHz)	19.72	16.15	11.66	8.26	3.84	2.19



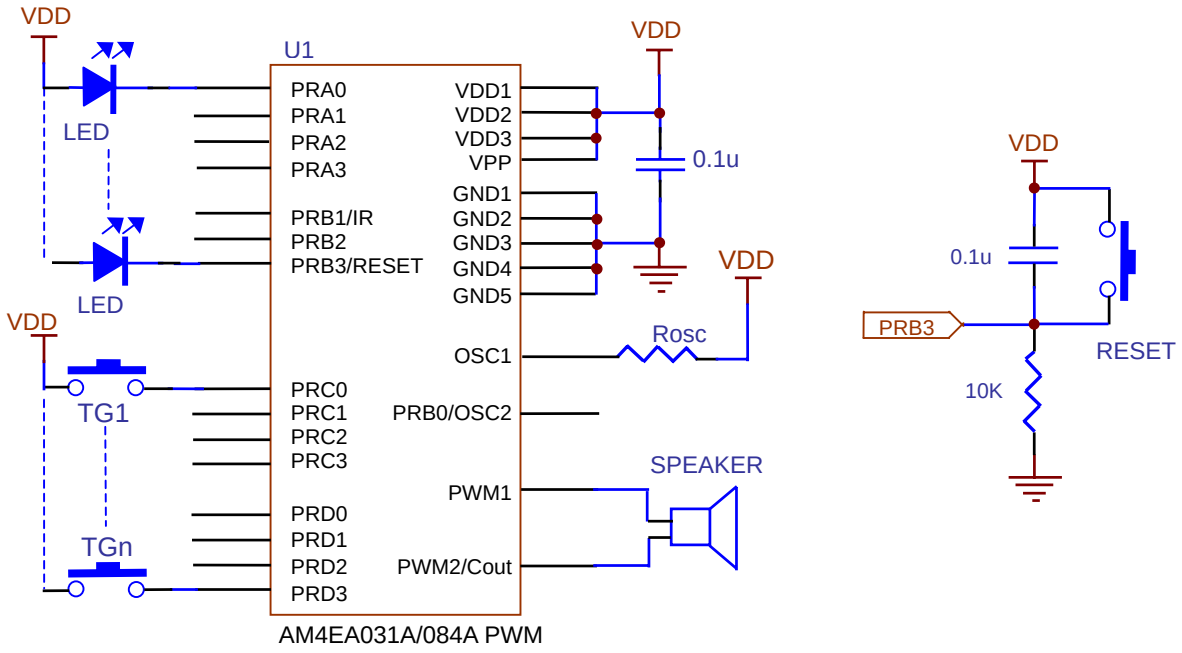
8. Application Circuit



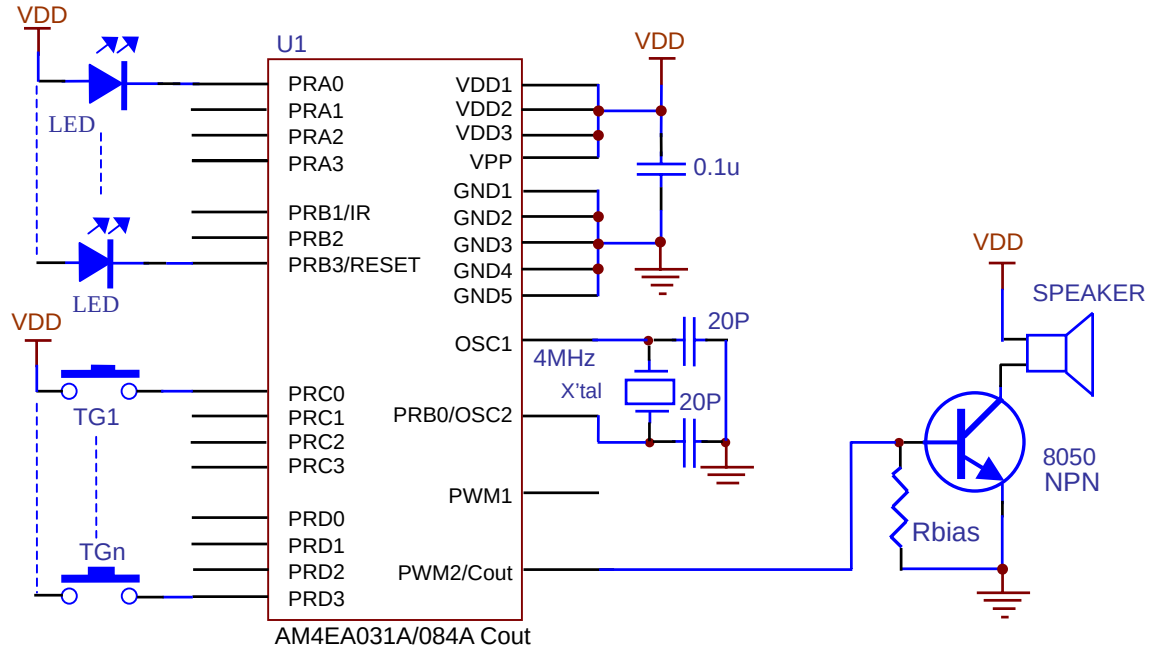
AM4EA015A PWM



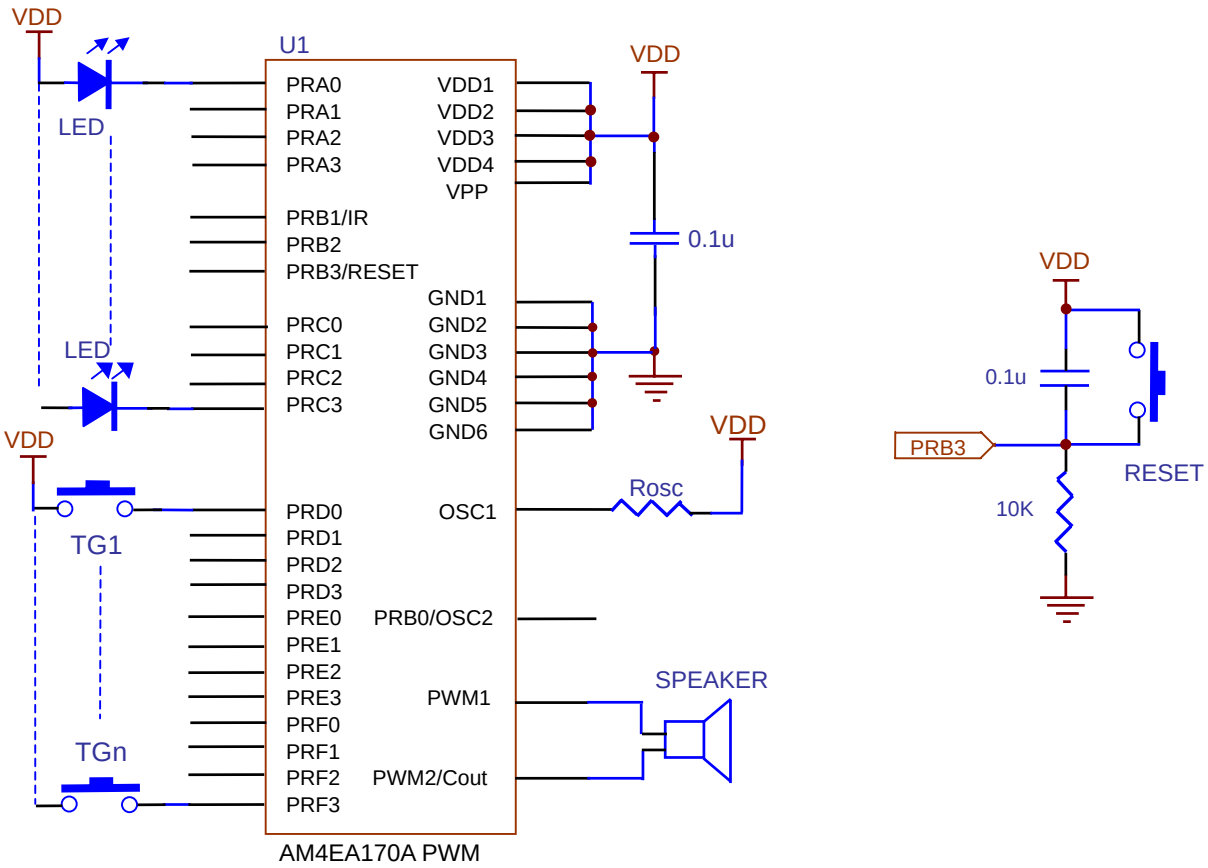
AM4EA015A Cout

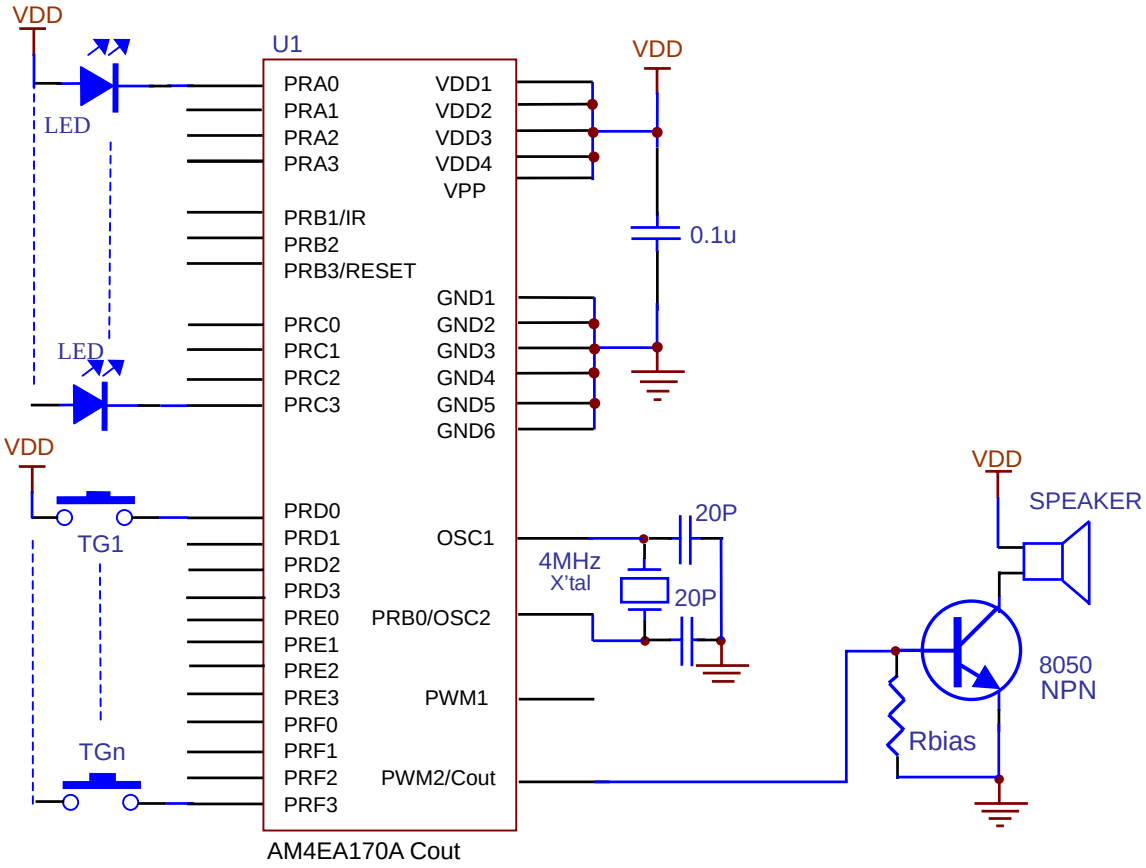


AM4EA031A/084A PWM



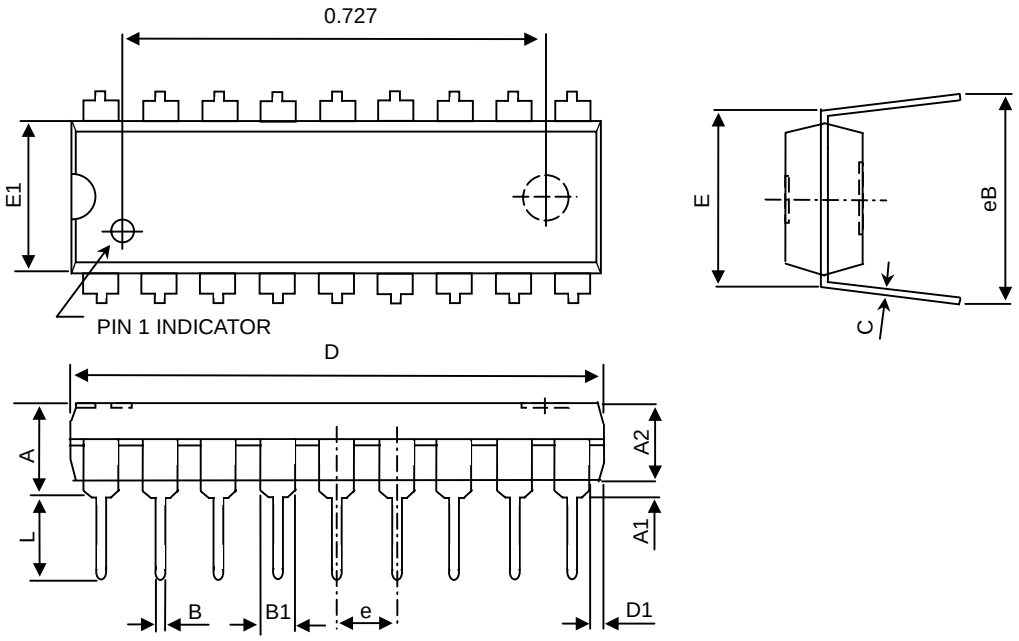
AM4EA031A/084A Cout


VDD
U1
LED
LED
VDD
TG1
TGn
PRA0
PRA1
PRA2
PRA3
PRB1/IR
PRB2
PRB3/RESET
PRC0
PRC1
PRC2
PRC3
PRD0
PRD1
PRD2
PRD3
PRE0
PRE1
PRE2
PRE3
PRF0
PRF1
PRF2
PRF3
VDD1
VDD2
VDD3
VDD4
VPP
GND1
GND2
GND3
GND4
GND5
GND6
OSC1
PRB0/OSC2
PWM1
PWM2/Cout
0.1u
Rosc
SPEAKER
AM4EA170A PWM
PRB3
RESET
10K


VDD
U1
LED
LED
VDD
TG1
TGn
PRA0
PRA1
PRA2
PRA3
PRB1/IR
PRB2
PRB3/RESET
PRC0
PRC1
PRC2
PRC3
PRD0
PRD1
PRD2
PRD3
PRE0
PRE1
PRE2
PRE3
PRF0
PRF1
PRF2
PRF3
VDD1
VDD2
VDD3
VDD4
VPP
GND1
GND2
GND3
GND4
GND5
GND6
OSC1
PRB0/OSC2
PWM1
PWM2/Cout
0.1u
20P
4MHz
X'tal
20P
SPEAKER
8050
NPN
Rbias
AM4EA170A Cout

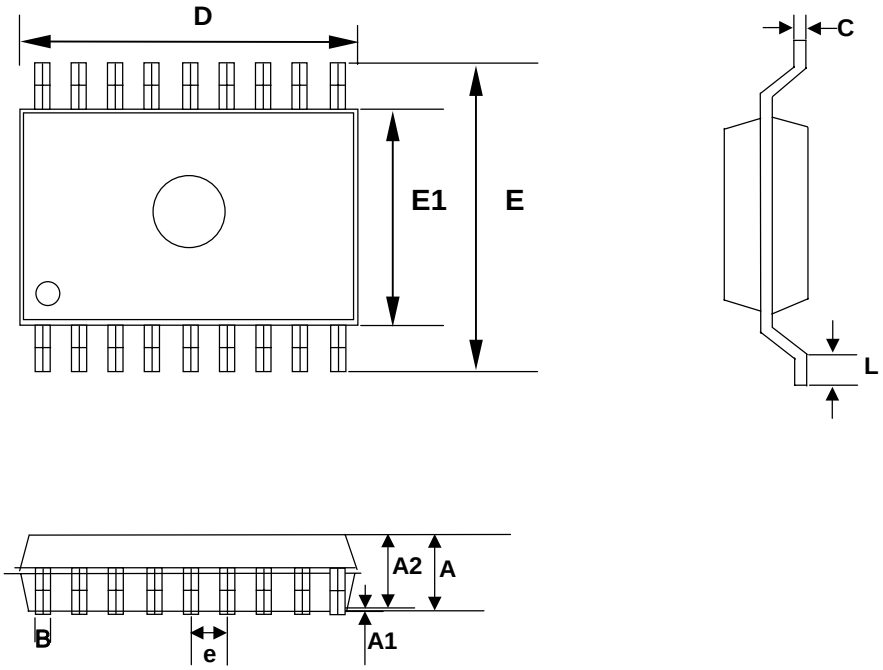
9. Package Dimension of AM4EA015A

18Pin Skinny DIP 300 mil



Symbols	Dimension In Millimeters			Dimension In Inches		
	Min	Nom	Max	Min	Nom	Max
A	-		4.75	-	-	0.18-
A1	0.38	-	-	0.015	-	-
A2	-	3.3	3.56	-	0.13	0.14
B	0.36	0.46	0.56	0.014	0.018	0.022
B1	1.27	1.52	1.78	0.05	0.06	0.07
C	0.2	0.25	0.33	0.008	0.01	0.013
D	22.71	22.96	23.11	0.894	0.904	0.91
E	7.62	-	8.26	0.017	0.022	0.027
E1	6.4	6.5	6.65	0.3	-	0.325
e	-	2.54	-	0.252	0.256	0.262
L	3.18	-	-	0.125	0.1	-
eB	8.38	-	9.65	0.33	-	0.38

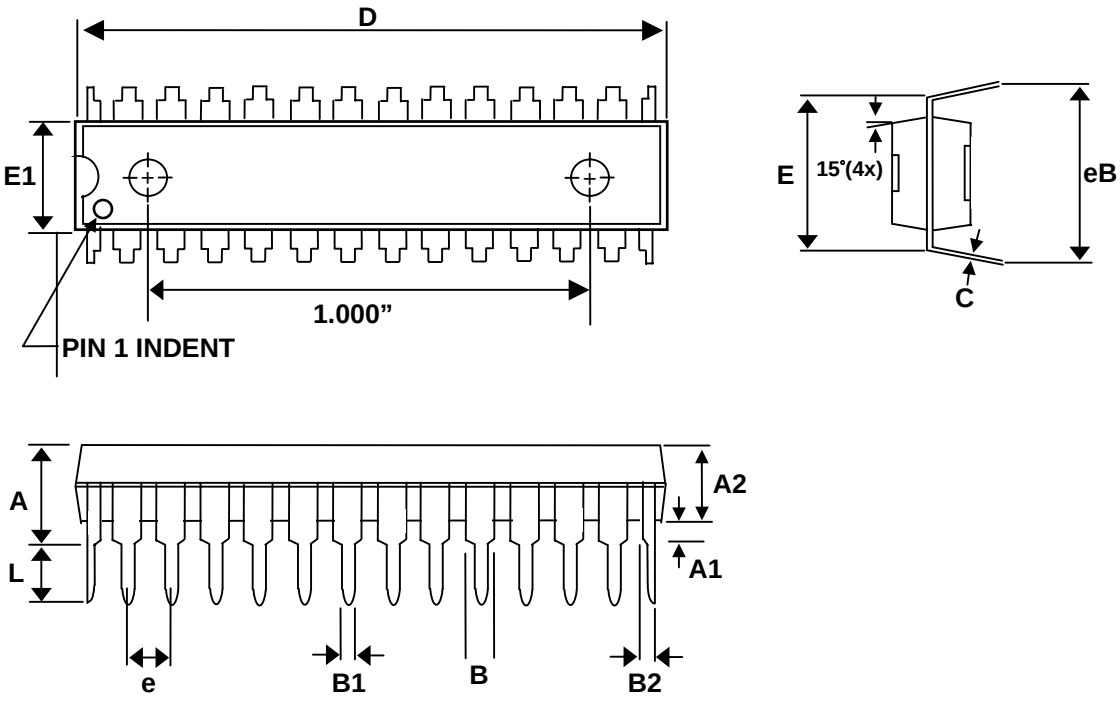
18Pin SOP 300 mil



Symbols	Dimension In Millimeters			Dimension In Inches		
	Min	Nom	Max	Min	Nom	Max
A	2.415	2.515	2.615	0.095	0.099	0.103
A1	0.128	0.178	0.228	0.005	0.007	0.009
A2	2.287	2.337	2.387	0.09	0.092	0.094
B	-	0.406	-	-	0.016	-
C	-	0.254	-	-	0.01	-
D	11.482	11.532	11.582	0.452	0.454	0.456
E	10.21	10.31	10.41	0.402	0.406	0.41
E1	7.418	7.468	7.518	0.292	0.294	0.296
e	-	1.27	-	-	0.05	-
L	0.686	0.762	0.838	0.027	0.03	0.033

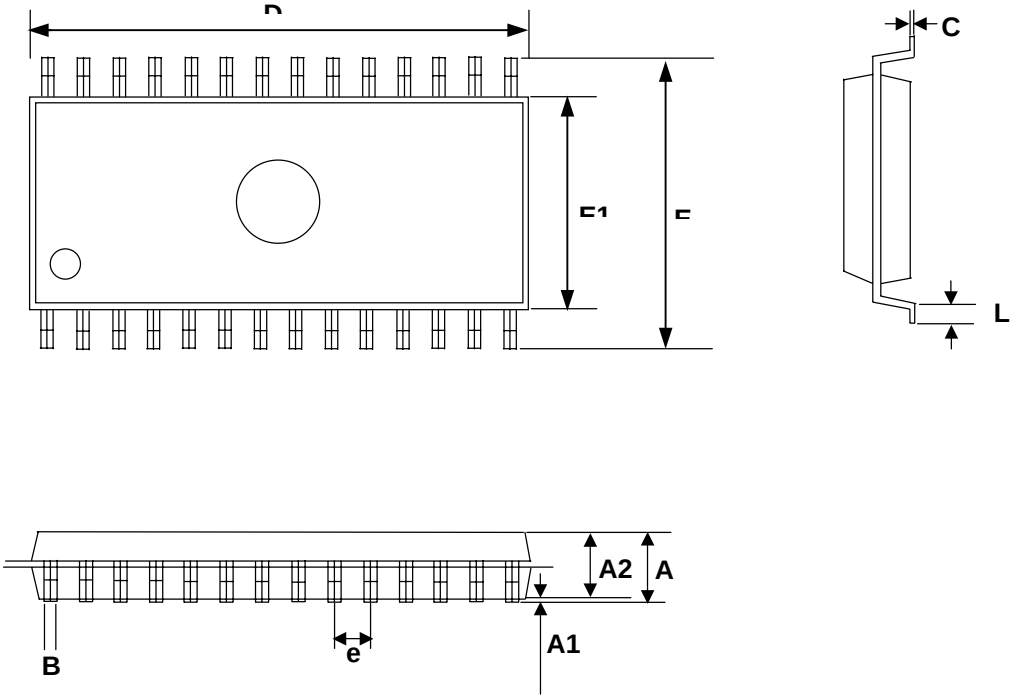
10. Package Dimension of AM4EA031A/AM4EA084A

28Pin Skinny DIP 300 mil



SYMBOLS	Dimension In Millimeters			Dimension In Inches		
	Min	Nom	Max	Min	Nom	Max
A	-		4.75	-	-	0.18
A1	0.38	-	-	0.015	-	-
A2	-	3.3	3.56	-	0.130	0.14
B	1.02	-	1.65	-	0.060	-
B1	0.41	-	0.58	0.004	-	0.065
C	0.2	0.25	0.33	0.016	-	0.023
D	35.13	35.18	35.43	1.383	1.385	1.395
E	7.87	8.31	8.38	0.31	0.327	0.33
E1	7.26	7.32	7.52	0.284	0.288	0.296
e	-	2.54	-	-	0.100	-
L	3.18	-	-	0.125	-	-
eB	8.64	-	6.95	0.340	-	0.38

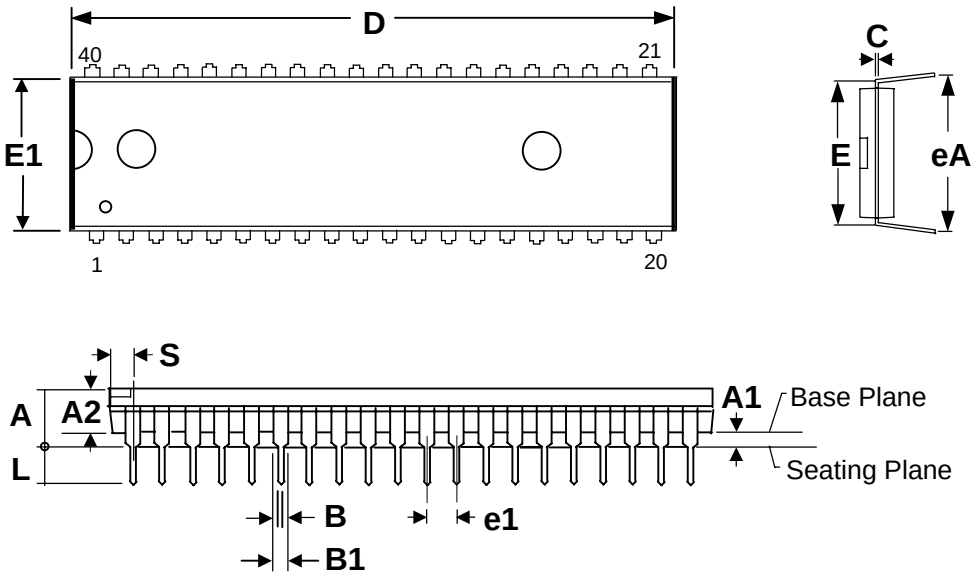
28Pin SOP 300 mil



Symbols	Dimension In Millimeters			Dimension In Inches		
	Min	Nom	Max	Min	Nom	Max
A	2.415	2.515	2.615	0.095	0.099	0.103
A1	0.1278	0.1778	0.2278	0.005	0.007	0.009
A2	2.287	2.337	2.387	0.090	0.092	0.094
B		0.406			0.016	
C		0.254			0.010	
D	17.731	17.831	17.881	0.698	0.702	0.704
E	10.21	10.31	10.41	0.402	0.406	0.410
E1	7.393	7.493	7.543	0.290	0.295	0.297
e		1.27			0.050	
L	0.686	0.762	0.838	0.027	0.030	0.033

11. Package Dimension of AM4EA170A

40Pin DIP 600 mil



Symbols	Dimension In Millimeters			Dimension In Inches		
	Min	Nom	Max	Min	Nom	Max
A	-	-	5.33	-	-	0.210
A1	0.25	-	-	0.010	-	-
A2	3.81	3.94	4.06	0.150	0.155	0.160
B	0.41	0.46	0.56	0.016	0.018	0.022
B1	1.22	1.27	1.37	0.048	0.050	0.054
C	0.20	0.25	0.36	0.008	0.010	0.014
D	-	52.20	52.58	-	2.055	2.070
E	14.99	15.24	15.49	0.590	0.600	0.610
E1	13.72	13.84	14.02	0.540	0.545	0.552
e1	2.29	2.54	2.79	0.090	0.100	0.110
L	3.05	3.30	3.56	0.120	0.130	0.140
eA	16.00	16.51	17.02	0.630	0.650	0.670
S	-	-	2.29	-	-	0.090