AM9AK 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

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

Revision History

Rev	Date	Description	Page
1.00	2012/9/28	New Release.	-

1 一般規格

AM9AK003x、AM9AK007x 皆爲單晶片 CMOS 語音合成 IC，他們都是非常低成本，且高實用性的語音 IC 產品。本系列使用 4-bit LOGPCM 編碼方式，可合成長達 3.24、7 秒之語音。藉由製造過程中更換光罩，將客戶需要之語音資料編寫入 ROM 中。AM9AK 系列只有 1 個 output 腳(O1)，可配合佑華所提供的 *EzSpeech* 工具軟體來進行開發。

2 特性

(1) 單一工作電壓範圍爲 2.2 ~ 5.5 伏特。

(2) 語音總長度可達 3.24、7 秒，且最多可被分割成 256 個語音段(Voice Section)，每段長度可不同。

(3) 在 6 KHz 取樣頻率下，每一段語音的長度分別最多可達 3.24、7 秒。

(4) 共有 256 個語音格(Voice Step)，僅可規劃成 1 對語音組(Subtable)，也就是說語音組最多可達 256 個語音格。每一語音格可指定一語音段搭配 O1 的輸出致能或非致能。

(5) 內建變頻振盪器，共有 8 種不同播放速度的選擇(播放速度：5 KHz ~ 14.5 KHz)：

A	B	C	D	E	F	G	H
14.5 KHz	11.6 KHz	9.7 KHz	8.3 KHz	6.8 KHz	6 KHz	5.5 KHz	5 KHz

(6) AM9AK 只有**長響模式**(O1 爲輸出，上電後 IC 持續播放 Subtable 1)。

(7) O1 有以下 5 種輸出選擇：

   a) **Busy_High active**：播放時送出高準位訊號。

   b) **Busy_Low active**：播放時送出低準位訊號。

   c) **3 Hz LED flash**：播放時 LED 3 Hz 閃爍。(當播放速度爲 6 KHz 時)

   d) **6 Hz LED flash**：播放時 LED 6 Hz 閃爍。(當播放速度爲 6 KHz 時)

   e) **12 Hz LED flash**：播放時 LED 12 Hz 閃爍。(當播放速度爲 6 KHz 時)

   注意：3 Hz / 6 Hz / 12 Hz LED flash 是指以 6 KHz 的速度播放時，LED 閃爍的頻率；不同的播放速度，LED 閃爍的頻率也會不同。

(8) PWM1、PWM2 可直接驅動 Buzzer 或 8、16、32、64Ω的 Speaker。

(9) 每一語音段中的語音或靜音長度爲 100 HEX 的整數倍。

1. General Description

AM9AK003x and AM9AK007x are single-chip voice synthesizing CMOS ICs. They come with low-cost and highly-applicable features and are capable of synthesizing voice up to 3.24 or 7 seconds using 4-bit LOGPCM algorithm. Customer's speech data can be programmed into ROM by changing one mask during the device fabrication. In AM9AK series, only one output pin (O1) is available for user to apply; in addition, user can program AM9AK series along with *EzSpeech*, a user-friendly development system designed by Alpha, to boost its application.

2. Features

(1) Single power supply can operate from 2.2 V to 5.5 V.

(2) The total voice duration can be up to 3.24 or 7 seconds and can be partitioned up to 256 voice sections. The length of each voice section is flexible.

(3) At a 6 KHz Sample Rate (S.R.), the duration for each voice section can be up to 3.24 or 7 seconds.

(4) There are a total of 256 voice steps, which can only be divided into 1 Subtable. That is, up to 256 voice steps can be grouped in a subtable. For each voice step, it can specify one voice section with enabling or disabling O1 output.

(5) Support a built-in oscillator with 8 kinds of playback speed option, ranged from 5 KHz to 14.5 KHz.

| A	B	C	D	E	F	G	H
14.5 KHz	11.6 KHz	9.7 KHz	8.3 KHz	6.8 KHz	6 KHz	5.5 KHz	5 KHz

(6) AM9AK only supports **Continuous Play** mode wherein O1 is an output and IC will keep playing Subtable 1 after power-on.

(7) 5 kinds of output option for O1:

   a) **Busy_High active:** Output a high active signal during voice playing.

   b) **Busy_Low active:** Output a low active signal during voice playing.

   c) **3 Hz LED flash:** Output 3 Hz sink signal for driving LED during voice playing at a 6 KHz S.R.

   d) **6 Hz LED flash:** Output 6 Hz sink signal for driving LED during voice playing at a 6 KHz S.R.

   e) **12 Hz LED flash:** Output 12 Hz sink signal for driving LED during voice playing at a 6 KHz S.R.

   Note: 3 Hz, 6 Hz and 12 Hz LED flash mentioned above are generated specifically at a 6 KHz sample rate. The frequency of LED flash may vary based on different sample rates.

(8) PWM1 and PWM2 can directly drive Buzzer, as well as 8, 16, 32 or 64 ohms speakers.

(9) The length of voice or mute in each voice section must be multiples of 100 Hex.

3. Block Diagram
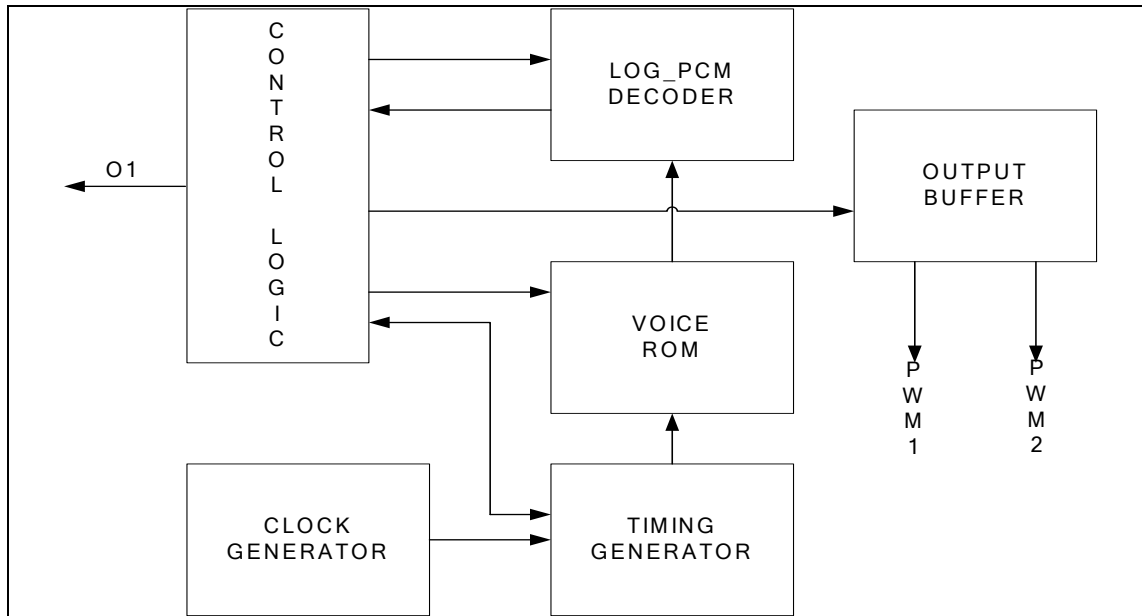
4. Pin Description

Name	No.	ATTR.	Function
O1	6	O	Status output.
VSS1	5	Power	Negative power supply.
VDD	2	Power	Positive power supply.
VSS	1	Power	Negative power supply.
PWM1	3	O	Audio output.
PWM2	4	O	Audio output.

5. Code Development and Demonstration

User can use *EzSpeech* software tool to develop the desired functions. For details, please refer to *EzSpeech* User Manual. After finishing code programming, two files of .eva and .htm, one binary file and a function checklist will be generated. User can download the .eva file into AM9CA_DB demo board to demonstrate AM9AK functions. The related mapping of AM9CA_DB is given as follows:

	AM9AK	AM9CA_DB	AM9CA_DB Description
I/O Pin	-	OKY	OKY must connect to VDD to demo AM9AK's function.
	O1	IO1	O1 can only be a status output.
	PWM1, PWM2	PWM1, PWM2	PWM output to directly drive speakers.
	-	R$_{OSC}$	Rosc is connected with 146K ohms resistor at 6 KHz S.R.

Note: If the R$_{OSC}$ value is changed, the S.R. for all voice sections should be changed accordingly as below.

R_{OSC}	175K	160K	146K	130K	105K	90.3K	75K	60K
S.R.	5 KHz	5.5 KHz	6 KHz	6.8 KHz	8.3 KHz	9.7 KHz	11.6 KHz	14.5 KHz

Once the function has been approved, user only needs to send the .eva file to Alpha for code tape-out.

6. Absolute Maximum Rating

Symbol	Rating	Unit
$V_{SS} \sim V_{DD}$	-0.5 ~ +7.0	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	ºC
T_{ST} (storage)	-25 ~ +85	ºC

7. DC Characteristics

| Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
V_{DD}	Operating Voltage		2.0	3.0	5.5	V	
F_{OSC}	Operating Frequency		640	768	1856	KHz	Play Speed: 5 KHz ~ 14.5 KHz
I_{sb}	Supply Current	Standby			1	uA	V_{DD} = 3 V, I/O open 6 KHz S.R.
I_{OP}		Operating		500			
I_{OH}	PWM1, PWM2 output current			-86		mA	V_{DD} = 3 V, V_{OH} = 2.4 V
I_{OL}				108			V_{DD} = 3 V, V_{OL} = 0.6 V
I_{OH}	O1 output current			-3		mA	V_{DD} = 3 V, V_{OP} = 2.6 V
				-7			V_{DD} = 4.5 V, V_{OP} = 3.7 V
				131			V_{DD} = 3 V, V_{OP} = 0.4 V
I_{OL}				286			V_{DD} = 4.5 V, V_{OP} = 0.8 V
dF/F	Frequency stability			3		%	$\dfrac{\text{Fosc (3 V) - Fosc (2.4 V)}}{\text{Fosc (3 V)}}$
dF/F	Frequency stability			3		%	$\dfrac{\text{Fosc (4.5 V) – Fosc (3 V)}}{\text{Fosc (3 V)}}$
dF/F	F_{OSC} lot variation		-4		4	%	V_{DD} = 3 V, 4.5 V

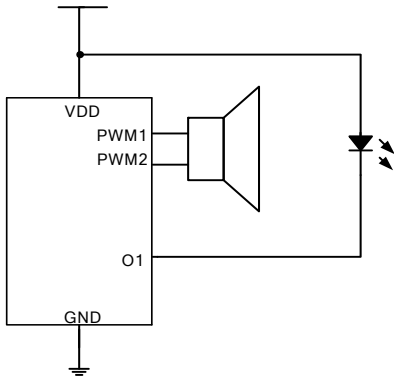# 8. Timing Diagram

8.1 Status Output (O1)
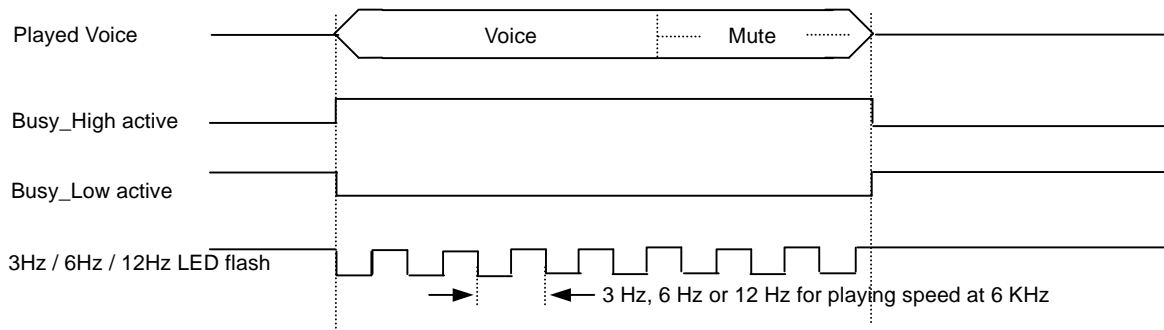
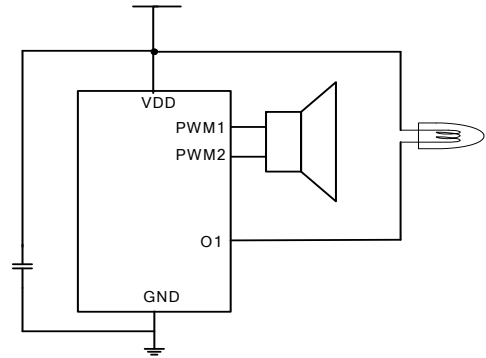## 8.2 General Timing Diagram

Continuous Play Mode
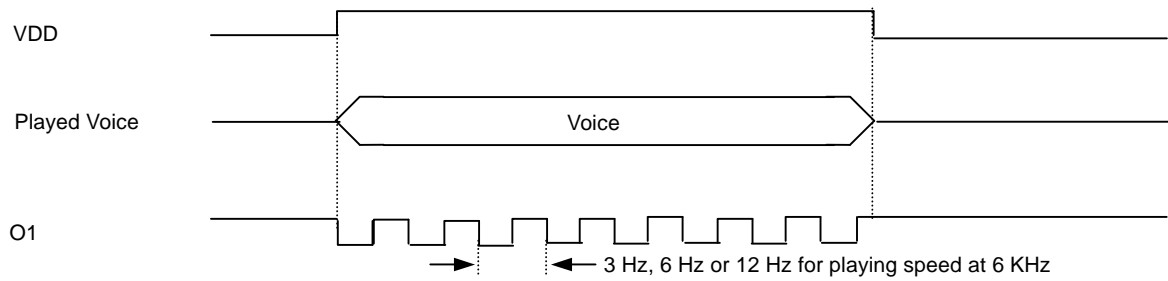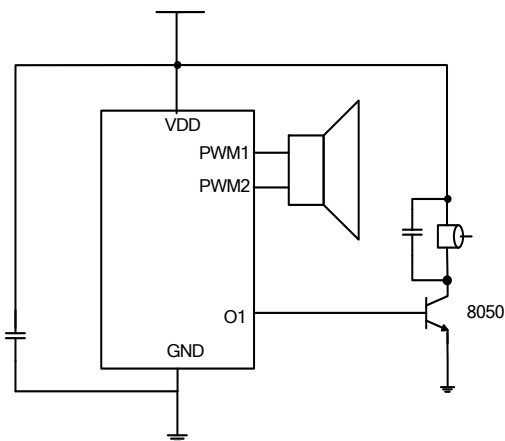
9. Application Circuit
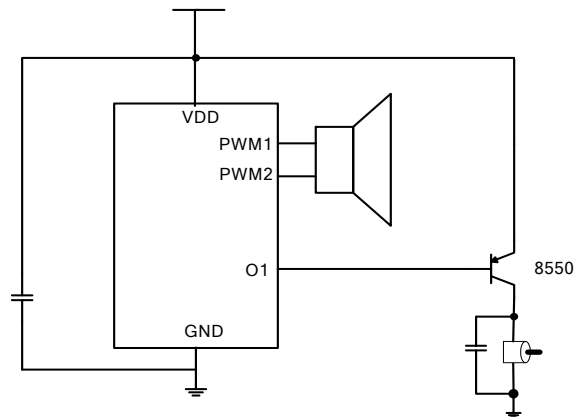
(1) Continuous Play, 1 LED

(2) Continuous Play, 1 Bulb

(3) Continuous Play, 1 motor

(4) Continuous Play, 1 motor

* O1 is an output, select **Busy_High** for driving motors.

* While driving motor, one capacitor is recommended to be connected between VDD and GND.

* O1 is an output, select **Busy_Low** for driving motors.

* While driving motor, one capacitor is recommended to be connected between VDD and GND.

Note: The above application circuits are for reference only. User can contact Alpha for more information.

10. Bonding Diagram
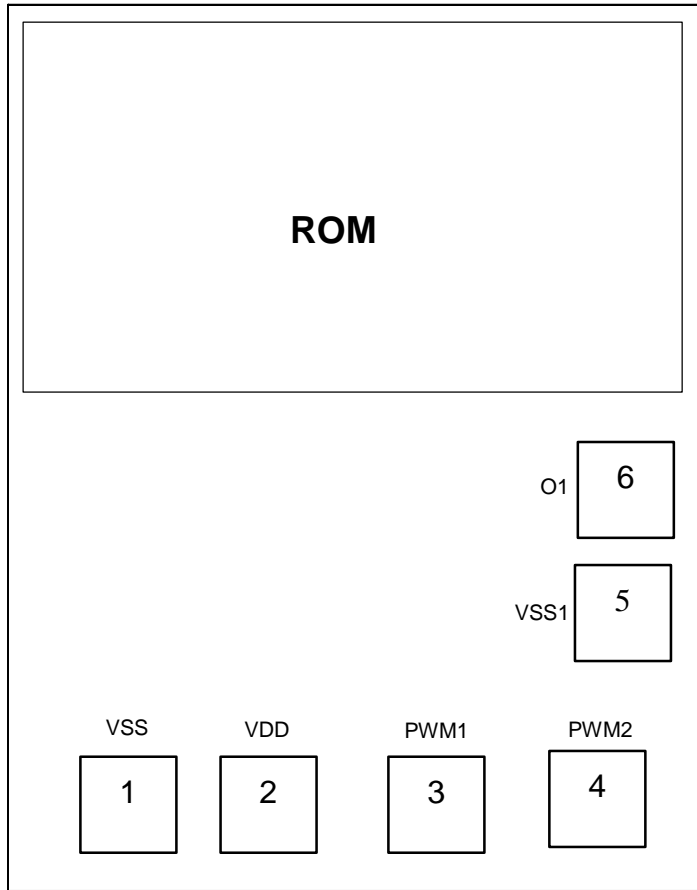
Note: The IC substrate must be connected to GND.

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