AM9BF Series

Data Sheet

佑華微電子股份有限公司　　*Alpha Microelectronics Corp.*

新竹市光復路二段295號9樓之1號　　9F-1, 295, Sec. 2, Kuang Fu Rd., Hsinchu, Taiwan

電話: 03-573 6660　　Tel : +886-3-573 6660

傳真: 03-573 6661　　Fax: +886-3-573 6661

www..ealpha.com.tw　　www.ealpha.com.tw

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Revision History

Revision	Date	Description	Page
1.0	2010/6/24	Original.	-

1. 一般規格

AM9BF003x、AM9BF007x、AM9BF010x、AM9BF014x、AM9BF021x、AM9BF028x、AM9BF035x、AM9BF042x，皆為單晶片 CMOS 語音合成 IC，他們都是非常低成本，同時具有相當實用功能的語音 IC 產品。他們以 APCM 編碼方式，合成長達 3.5、7、10、14、21、28、35、42 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。另外使用者可以有最多 2 個很彈性的 PowerIO pin 選擇(IO1, IO2)，來配合不同之應用，並可用佑華所提供的 EzSpeech 工具軟體來進行開發。

2. 特性

(1) 單一工作電壓範圍為 2.2 ~ 5.5 伏特。

(2) 語音總長度可達 3.5、7、10、14、21、28、35、42 秒，且最多可被分割成 256 個語音段(voice_section)，每段長度可不同。

(3) 每一段語音的長度分別最多可達 3.5、7、10、14、21、28、35、42 秒。(在 6kHz 取樣頻率下)
每一段 "靜音時間" 的長度，最多可達 43 秒。(在 6kHz 取樣頻率下)
每一段語音可編入兩組 Sync 信號(2 個 Sync 給 IO1, IO2 使用)，可由 PowerIO 編輯器來做 Sync 信號編輯。

(4) 共有 256 個語音格(voice_step)，可規劃成 32 對語音組(sub_table)，每個語音組可放的語音格並沒有限制(但最多只有 256 個語音格)。每一語音格可指定一語音段和播放速度，並搭配 IO1 和 IO2 的輸出致能或非致能(IO1 和 IO2 當作輸出時)。

(5) 內建變頻振盪器，使用者可在 4.4kHz ~ 15kHz 中選擇任意播放速度。

(6) OKY 只能作為輸入，IO1 與 IO2 可選擇作輸入腳或是輸出腳 (光罩選擇)。

(7) 可選擇電源啟動(PowerOnPlay)觸發輸入或按鍵觸發輸入模式。

   (a) 每一種輸入可選擇不同觸發方式 (光罩選擇)：
   邊緣觸發 / 位準觸發 (Edge/Level)；保持 / 非保持 (Hold/Unhold)；後段蓋前段 / 非後段蓋前段 (Retrigger/Irretrigger)。
   (※ PowerOnPlay 觸發輸入模式只能固定為 Edge / Unhold / Retrigger)

   (b) OKY 輸入最多有 32 個 sub_table 的 One-Key sequential 或 random 的選擇，在 One-Key sequential 時並可選擇 sub-table 的順序是否要 Reset(當其他按鍵被觸發後)。

   (c) OKY, IO1, IO2 其中之一 輸入可選擇是否有 Toggle On/Off 的功能。

   (d) OKY 輸入可選擇 40K pull-low、CDS+1M、CDS、1M pull-low 或 floating 的輸入方式。IO1, IO2 輸入可選擇 CDS+1M、CDS、1M pull-low 或 floating 的輸入方式。

   (e) 每一種輸入可選擇不同防止誤動作(Debounce)時間：Long - 提供一般手動操作；Short - 提供跳動開關使用。

   (f) 優先順序：OKY>IO1>IO2>PowerOnPlay。

(8) IO1, IO2 可做以下 4 種輸出選擇：

    (a) LED 3Hz flash：播放時 LED 3Hz 閃爍。(當播放速度為 6kHz 時)

    (b) LED 6Hz flash ： 播放時 LED 6Hz 閃爍。(當播放速度為 6kHz 時)

    (c) LED dynamic 2/4：播放時 LED 動態 2/4 位準訊號。

    (d) Power IO 輸出：可隨聲音作任意的輸出變化(需開啟 PowerIO 編輯器來做 Sync 信號編輯)。

   (※ LED 3Hz / 6Hz flash 是指以 6kHz 的播放速度 時，LED閃爍的頻率；不同的播放速度，LED閃爍的頻率也會不同。)

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

(10) 每一語音段中的語音與靜音長度為 40HEX 的整數倍。

輸入方式選項：

選 項	功 能 描 述
40K pull-low	IC內部為 40K 的下拉電阻，給一些按鍵阻抗較小，系統雜訊較大的應用使用。
CDS + 1M	一般選項，大多用在按鍵觸發。當按鍵按下時，IC 內部為 1M 的下拉電阻；而當按鍵放開時，IC 內部為 1M+300K(並聯)的下拉電阻。
CDS	IC內部為 300K 的下拉電阻，通常與光敏電阻一起使用。
1M pull-low	IC內部為 1M 的下拉電阻，保留給一些特殊應用使用。
Floating	IC 內部無下拉電阻，通常連接到其他輸出腳來做控制使用；如果沒連接其他輸出腳，一定要將此腳位外拉電阻到地。

* IO1, IO2 當輸入時，沒有 40K pull-low 的選項。

Trigger Pad

Buffer

1M Pull-low   40K Pull-low   300K Pull-low
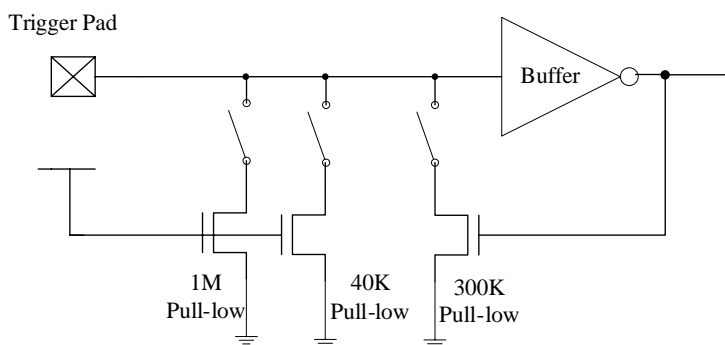
1. GENERAL DESCRIPTION

The AM9BF003x, AM9BF007x, AM9BF010x, AM9BF014x, AM9BF021x, AM9BF028x and AM9BF035x, AM9BF042x are single-chip voice synthesizing CMOS IC. They are low cost with proper functions and can synthesize voice up to 3.5, 7, 10, 14, 21, 28 , 35 and 42 seconds, using APCM algorithm. Customer speech data can be programmed into ROM by changing one mask during the device fabrication. Besides, not only the very flexible and functional PowerIO pins (IO1, IO2) are available for user to apply in various applications, but also an interactive development tool "EzSpeech" is ready for user-friendly programming.

2. FEATURES

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

(2) The total voice duration is about 3.5, 7, 10, 14, 21, 28 , 35 and 42 seconds that can be partitioned up to 256 voice_sections. Each voice_section length is flexible.

(3) Voice length can be individually up to 3.5, 7, 10, 14, 21, 28 , 35 and 42 seconds, and mute length can be individually up to 43 seconds at 6kHz sample rate for each voice_section. Two SYNC signal can be edited into each voice by PowerIO editor (2 Syncs for IO1 and IO2).

(4) Total 256 voice_steps are available for 32 sub_table. The number of voice_step for each sub_table is flexible, but maximum is 256. For each voice_step, it can specify one voice_section, playback speed and IO1 and IO2 output enable options if IO1 and IO2 are set as output.

(5) Built-in variable oscillator, user can choose any playback speed of 4.4kHz ~ 15kHz.

(6) OKY can only be input, IO1 or IO2 can be either input or output pin (Mask option).

(7) Optional PowerOnPlay or other Trigger Input.

    a) Each input pin has mask options for Edge/Level , Hold/Unhold and Retrigger/Irretrigger trigger modes.
(※ PowerOnPlay has only "Edge / Unhold / Retrigger" trigger mode.)

    b) OKY input can choose One-Key Sequential or Random for maximum 32 sub_tables. At One-Key Sequential, the Reset function of sub_table sequence can be chosen when other keys are triggered.

    c) One of OKY, IO1, IO2 input can choose Toggle On/Off function or not.

    d) OKY input can choose 40K pull-low, CDS+1M , CDS , 1M pull-low or floating input type. IO1, IO2 input can choose CDS+1M , CDS , 1M pull-low or floating input type.

    e) Each input can choose debounce time: Long debounce for push buttons. Short debounce for fast switches.

    f) Input pin priority：OKY > IO1 > IO2 > PowerOnPlay.

(8) IO1, IO2 has 4 kinds of output option :

    a) LED 3Hz flash : 3Hz sink signal output for driving LED during playing at 6kHz sample rate.

    b) LED 6Hz flash : 6Hz sink signal output for driving LED during playing at 6kHz sample rate.

    c) LED dynamic 2/4 : dynamic sink signal output for driving LED during playing.

    d) Power IO output : arbitrary output with voice, user can edit the Sync signal by PowerIO editor.

    (※ Where (a) and (b) is the LED flash rate at 6kHz sample rate. For different sample rate, the LED flash rate is different from original 3Hz or 6Hz.)

(9) PWM1 and PWM2 can directly drive buzzer or 8, 16, 32 or 64 ohms speaker.

(10) The voice or mute length in voice_section must be the multiple of 40HEX.

※ **Input Type Description:**

Option	Description
40K pull-low	Internal 40K ohms pull-low resistance, usually for large noise applications.
CDS + 1M	Normal selection for button trigger. Only 1M pull-low resistance when key-pressed, and 1M+300K (parallel) pull-low resistance when key-released.
CDS	Internal 300K ohms pull-low resistance, usually for photo-resistor trigger.
1M pull-low	Internal 1M ohms pull-low resistance, reserve for some special applications.
Floating	No internal resistor connection, usually connected to other output pin or connected to GND by an external resistor.

* 40K pull-low option is not available for IO1, IO2 input.

Trigger Pad

Buffer

1M Pull-low   40K Pull-low   300K Pull-low
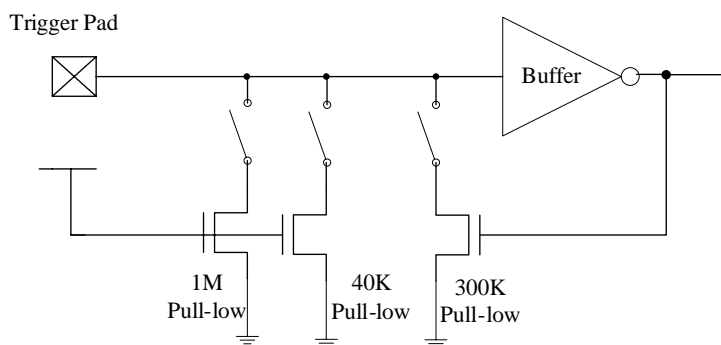
3. BLOCK DIAGRAM
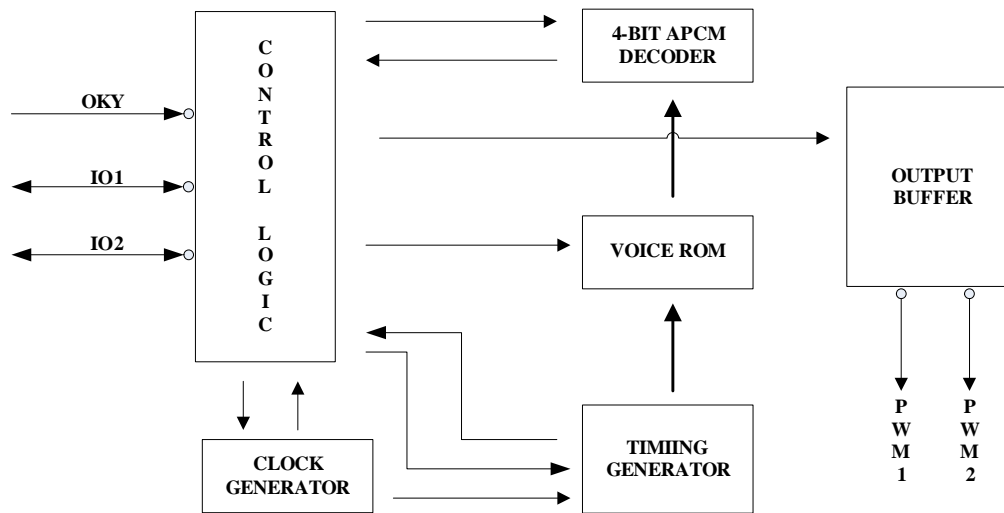
4. PAD DESCRIPTION

Pad Name	Pad No.	ATTR.	Function
OKY	1	I	Input for trigger.
IO1, IO2	2, 3	I/O	Status output or input for trigger.
GND	4	Power	Negative power supply.
VDD	5	Power	Positive power supply.
PWM1	6	O	Audio output.
PWM2	7	O	Audio output.

5. CODE DEVELOPMENT & DEMO SYSTEM

User can use "EzSpeech" software tool to develop the desired functions. For details, please see EzSpeech user manual. After finishing the code programming, user will get 2 files of "**.eva**" and "**.htm**", the binary file and function check list. User can download the "**.eva**" file into AM9CA_DB demo board to demonstrate the AM9BF function. The related mapping of AM9CA_DB is as following,

	AM9BF	AM9CA_DB	AM9CA_DB Description
I/O Pin	OKY	OKY	The same.
	IO1, IO2	IO1, IO2	The same.
	PWM1, PWM2	PWM1, PWM2	PWM output to directly drive speaker.

For some input type option, user may need to connect an external resistor. Please refer to the table below.

	AM9BF	AM9CA_DB	AM9CA_DB Description
Input Type	CDS + 1M	CDS + 1M	The same.
	CDS	CDS	The same.
	40K pull-low	40K pull-low	The same.
	1M pull-low	1M pull-low	The same.
	Floating	Floating	The same.

Once the function has been approved, user only need 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 CHARBDTERISTICS

Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
V_{DD}	Operating voltage		2.2	3.0	5.5	V	
F_{osc}	Operating Frequency		1126	1536	3840	KHz	Play Speed: 4.4K ~ 15K Hz
Isb	Supply current	Standby			1	uA	V_{DD}=3V, 6kHz S.R., no load
Iop		Operating		500			
Iih	Input current (40K pull low)			100		uA	V_{DD}=3V
Iih	Input current (1M pull low)			3		uA	V_{DD}=3V
Iih	Input current (CDS)			10		uA	V_{DD}=3V
Ioh	PWM output current			-30		mA	V_{DD}=3V, Voh=2.4V
Iol				30			V_{DD}=3V, Vol=0.6V
Ioh	IO1/IO2 output current (normal)			-1.6		mA	V_{DD}=3V, Vop=2.6V
				-4.5			V_{DD}=4.5V, Vop=3.7V
Iol				3.8			V_{DD}=3V, Vop=0.4V
				9.5			V_{DD}=4.5V, Vop=0.8V
Iol	IO1/IO2 output current (large)			12			V_{DD}=3V, Vop=0.4V
				28			V_{DD}=4.5V, Vop=0.8V
dF/F	Frequency stability			3		%	$\dfrac{F_{osc}(3v) - F_{osc}(2.4v)}{F_{osc}(3v)}$
dF/F	Frequency stability			3		%	$\dfrac{F_{osc}(4.5v) - F_{osc}(3v)}{F_{osc}(3v)}$
dF/F	F_{osc} lot variation		-3		3	%	V_{DD}=3V

8. TIMING DIAGRAM

(1) Debounce Time

a) Trigger while no playing voice

Input

Played Voice
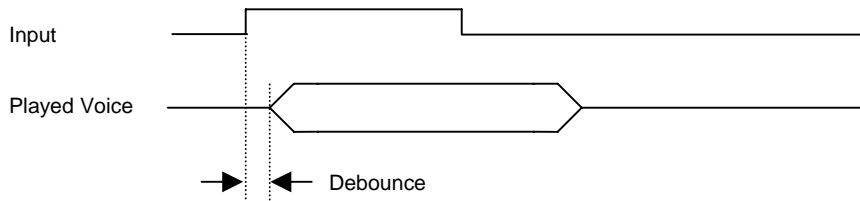
Debounce

※ Debounce time is configured by 6 kHz S.R and the value is fixed. That is, Slow debounce=20ms, Fast debounce < 50us

b) Trigger While playing voice
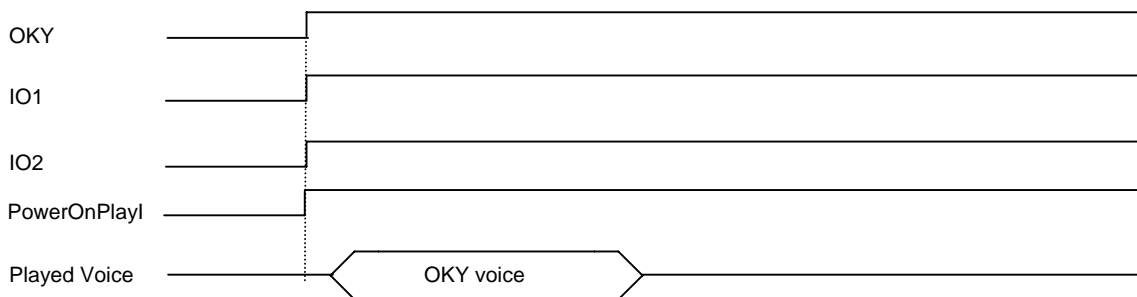
Input

Played Voice .… Step_m-1, Step_m   Step_n, Step_n+1, .…
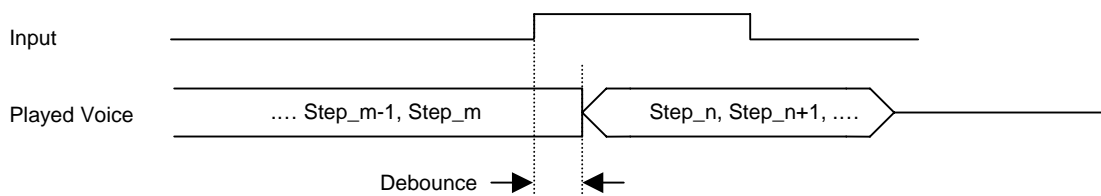
Debounce

※ Debounce Time is configured by the S.R. of Step_m.

For example, if Step_m S.R. = 8kHz, Slow debounce = 20*(6k/8k) ms = 15ms, Fast debounce < 50*(6k/8k) us =37.5us

(2) Input Priority

OKY

IO1

IO2

PowerOnPlayI

Played Voice   OKY voice

※ Priority: OKY > IO1 > IO2 > PlayOnPlay

(3) Status Output (IO1 & IO2)

Played Voice   Voice

LED 3Hz / 6Hz flash   3Hz or 6Hz for playing speed at 6kHz
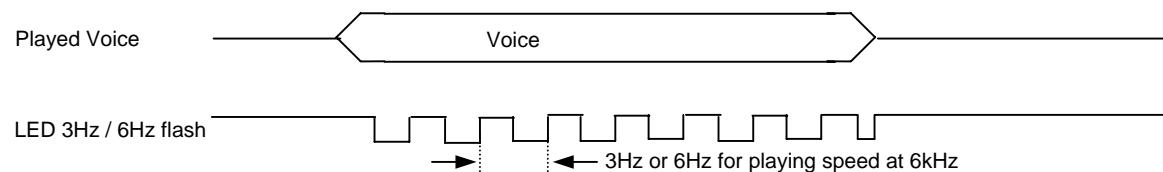
LED dynamic 2/4: When the voice amplitude is higher than 2/4 full-scale amplitude, LED will be ON, i.e. status output is low.

Power IO: arbitrary output with voice, user can edit the Sync signal by PowerIO editor.

(4) General Timing Diagram

a) Edge mode, Edge trigger

Input

Played Voice

Debounce

b) Edge mode, Level trigger

Input

Played Voice

Edge/Hold

Input

Played Voice
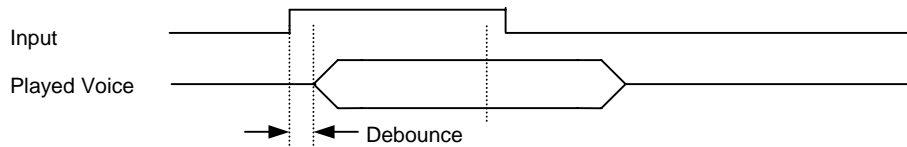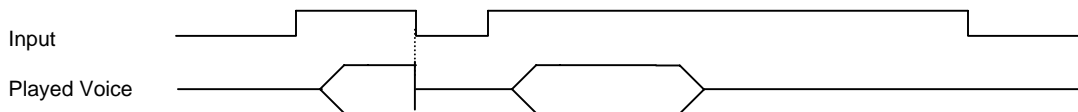
c) Level mode, Edge trigger

Input

Played Voice
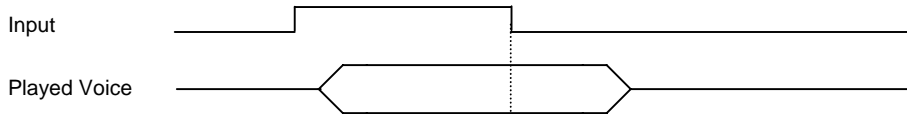
d) Level mode, Level trigger

Input

Played Voice

Level/Hold

Input

Played Voice

e) Retrigger mode

Input

Played Voice
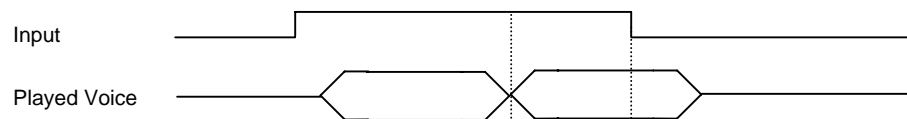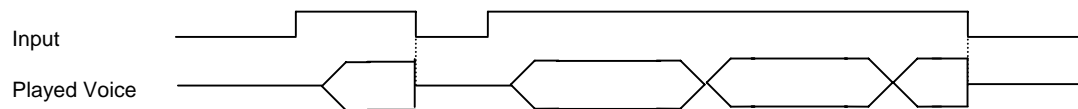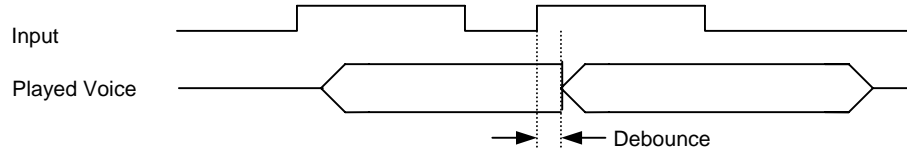
Debounce

f) Irretrigger mode

OKY

Played Voice
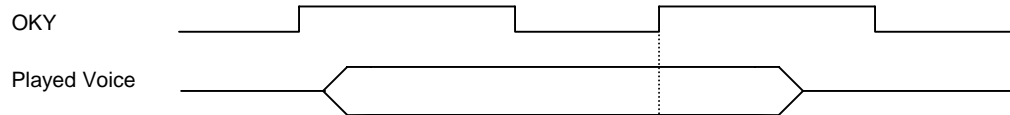
g) Retrigger mode, first key priority

OKY

IO1

Played Voice   OKY voice   IO1 voice   OKY voice

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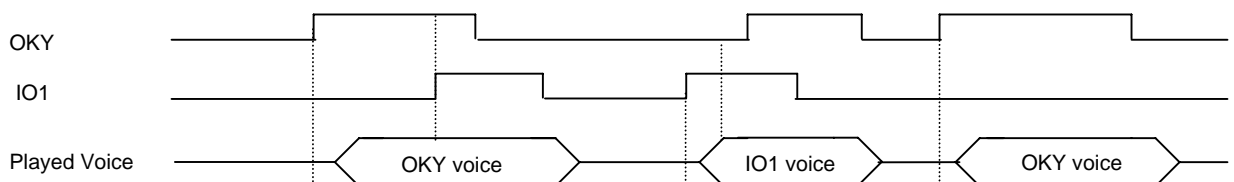
(5) Special Timing Diagram

Henceforth, the debounce time is ignored for the following diagrams.

a) Different Input Reload

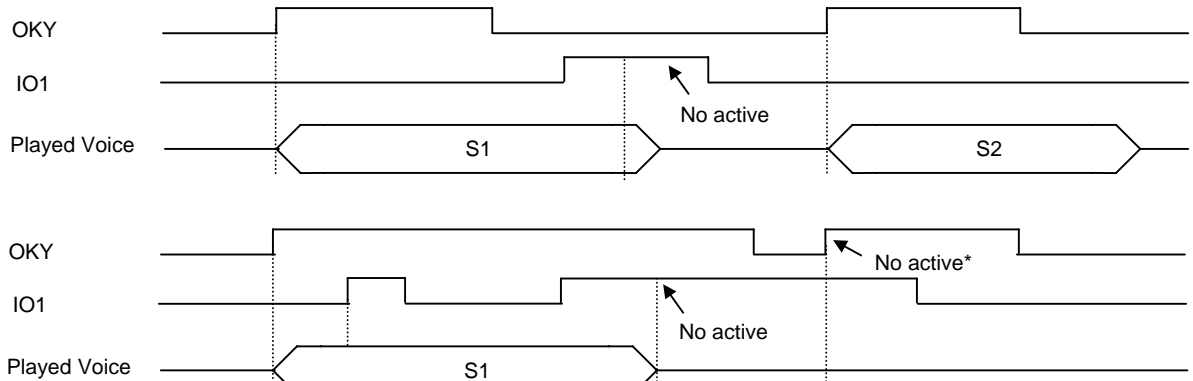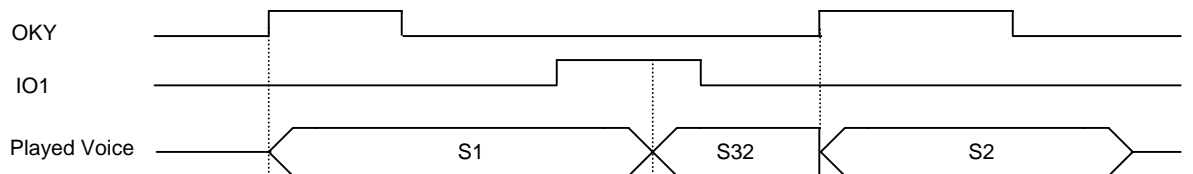I) OKY (E/U/R)=S1 S2 S3 S4, IO1(E/U/R)=S32 (S1 means sub_table 1)

OKY

IO1

Played Voice S1 S32 S2
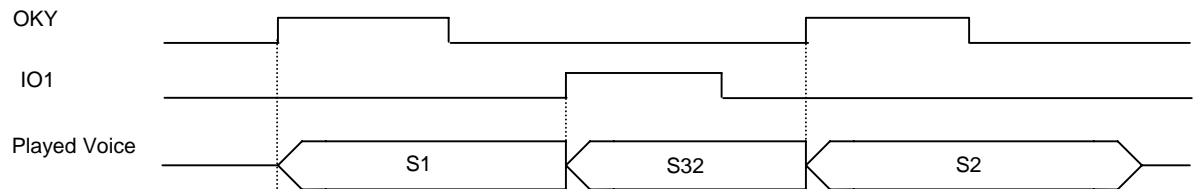
II) OKY (E/U/R) =S1 S2 S3 S4, IO1 (L/x/x) =S32

OKY

IO1

No active *

Played Voice S1 S2
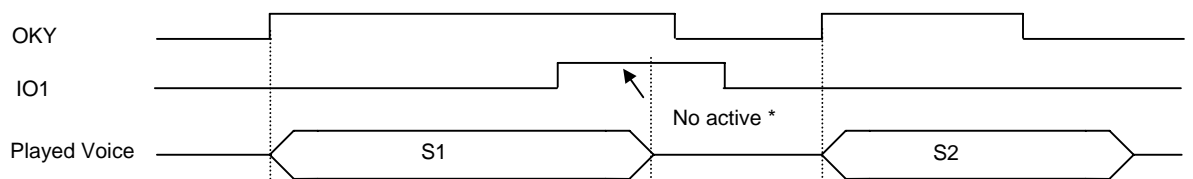
※ Reload key priority: OKY > IO1

III) OKY (E/U/I) =S1 S2 S3 S4, IO1 (E/x/x) =S32

OKY

IO1

No active

Played Voice S1 S2

OKY

No active*

IO1

No active

Played Voice S1

* Because IO1 signal is still high, the OKY Edge signal is not active.
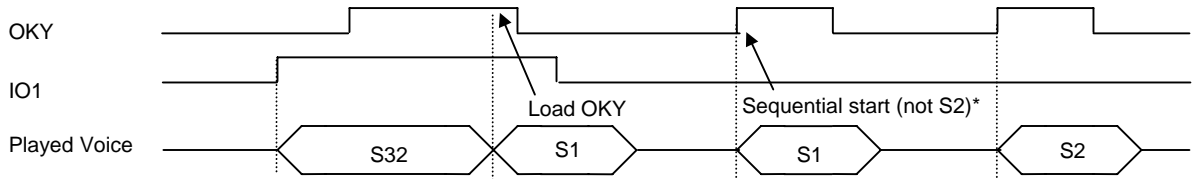
IV) OKY (E/U/I) =S1 S2 S3 S4, IO1 (L/U/R) =S32

OKY

IO1

Played Voice S1 S32 S2

V) OKY (L/U/x) =S1 S2 S3 S4, IO1 (E/x/x) =S32

OKY

IO1

No active

Played Voice S1 S1 S2
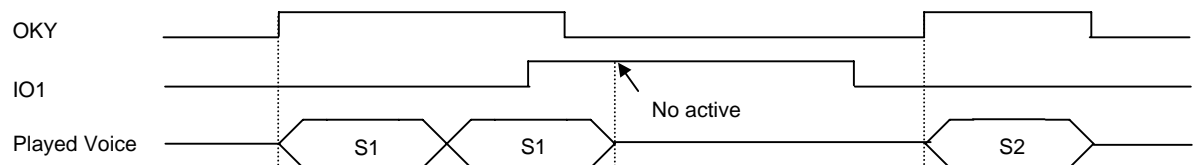
VI) OKY (L/U/x) =S1 S2 S3 S4, IO1 (L/U/x) =S32

OKY

IO1

IO1 active

Played Voice   S1   S1   S1   S32   S1

※ Reload key priority: OKY > IO1

OKY

IO1

Load OKY

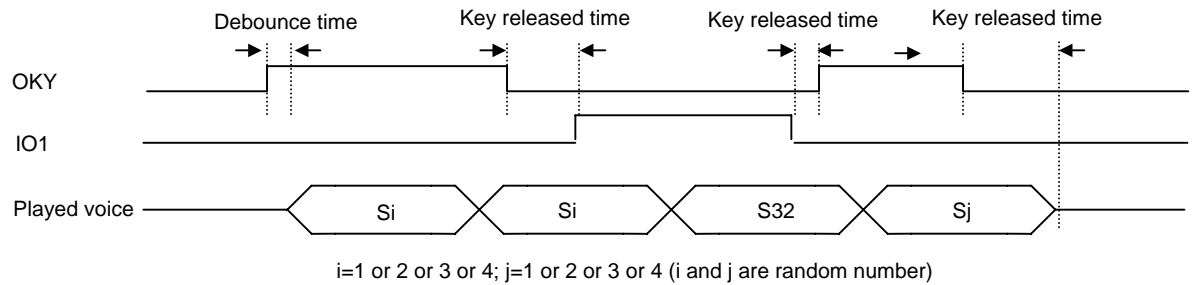Sequential start (not S2)*

Played Voice   S32   S1   S1   S2
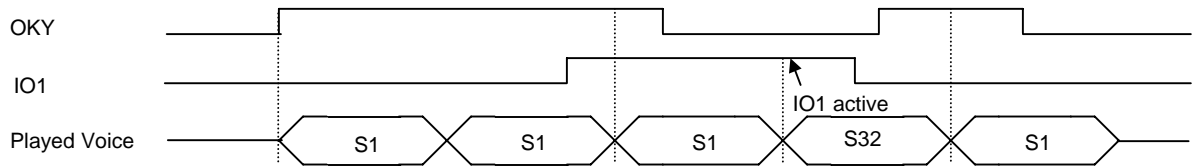
※ When IO1 is triggered first and its voice play, to trigger OKY don't follow sequential trigger because no debounce happen.

* In OKY, 1st debounce happen, so to play S1. OKY Sequential number is counted only if there is debounce happened.
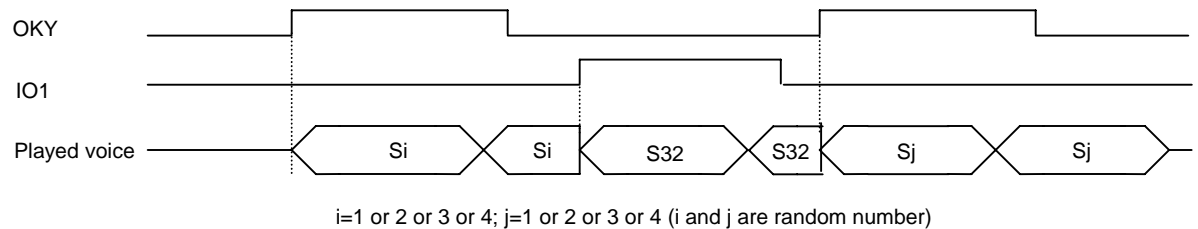
b) Random Function

I) OKY (L/U/I) =S1 S2 S3 S4, IO1 (L/U/I) =S32

Random is counting at "debounce time" and "voice playing but input key is released". But the first trigger only counts "debounce time" due to no "key release time".
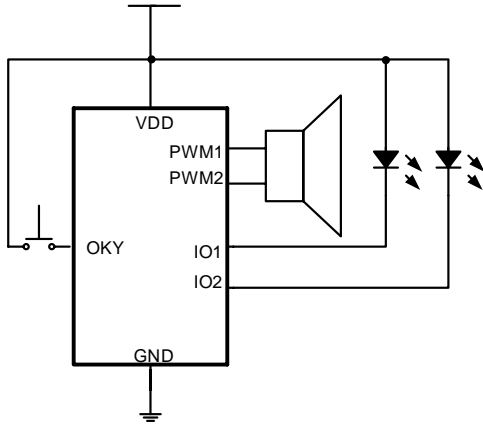
Debounce time   Key released time   Key released time   Key released time

OKY

IO1

Played voice   Si   Si   S32   Sj

i=1 or 2 or 3 or 4; j=1 or 2 or 3 or 4 (i and j are random number)

II) OKY (L/U/R) =S1 S2 S3 S4, IO1 (L/U/R) =S32

OKY

IO1

Played voice   Si   Si   S32   S32   Sj   Sj

i=1 or 2 or 3 or 4; j=1 or 2 or 3 or 4 (i and j are random number)
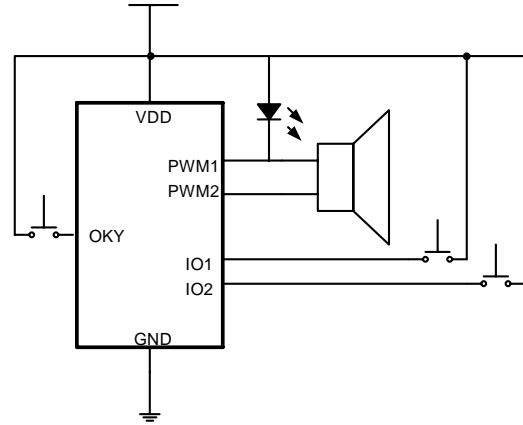
9. APPLICATION

(1) 1 trigger, 2 LEDs,
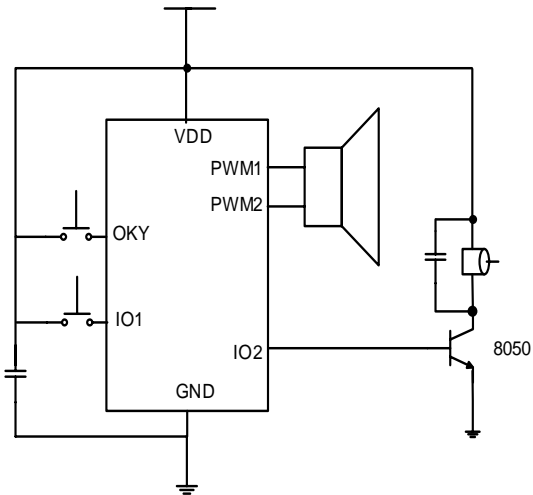
    OKY is input, IO1, IO2 is output

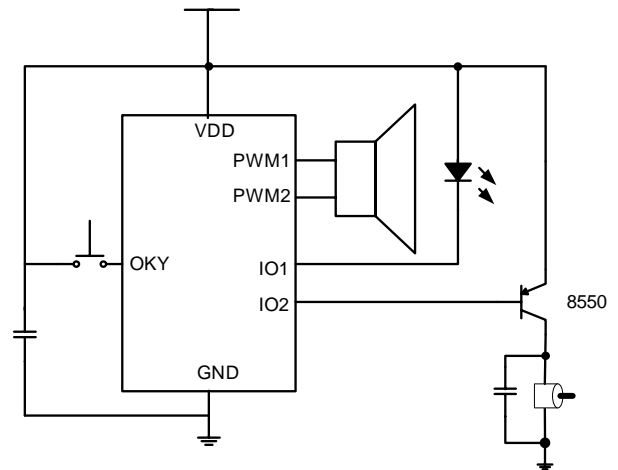(2) 3 triggers, 1 LED

(3) 2 triggers, 1 motor

    OKY and IO1 are input

(4) 1 trigger, 1 LED, 1 motor

    IO1 and IO2 are output

* IO2 is set to output mode, select "Sync output" for

  driving motors.

* While driving motor, one capacitor is suggested to

  put between Vdd and GND.

* IO1 and IO2 are set to output mode, select

  "Sync output" for driving motors.

* While driving motor, one capacitor is suggested to

  put between Vdd and GND.

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

10.BONDING DIAGRAM

ROM

Y

OKY IO1 IO2 GND VDD PWM1 PWM2

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

(0, 0)

X
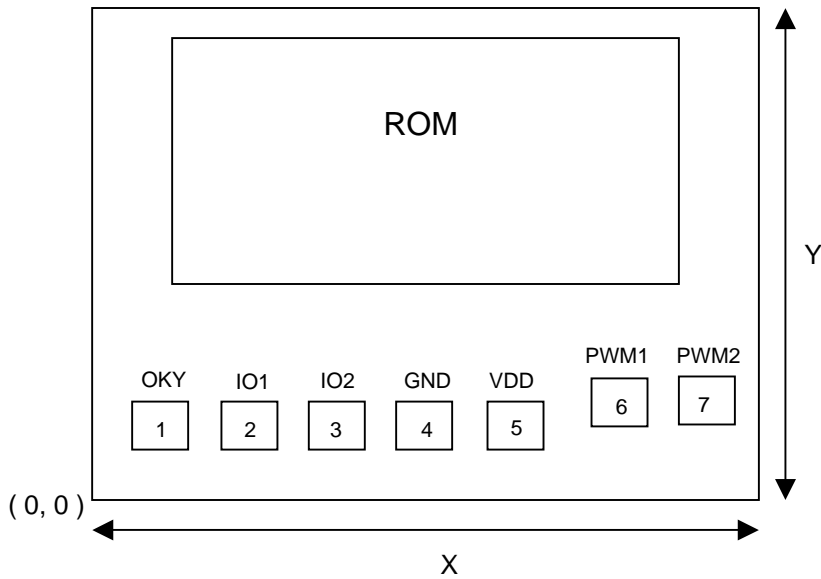
※ The IC substrate must be connected to GND.