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AM9AD Series
Data Sheet

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Rev 1.3 2006/11/2

Revision History

Revision#	Date	Description	Page
1.1	2004/2/24	Original.	-
1.2	2005/12/15	1. Amend voltage range. 2. Amend the binary file name to “eva” from “bin”. 3. Change demo system to AM9AA_DB demo board. 4. Amend I_{oh} & I_{ol} DC characteristics of IO1/O2. 5. Add status output of IO1 & O2. 6. Delete chip size.	3, 5, 10 9 9 10 11 27
1.3	2006/11/02	1. Add AM9AD028D/AM9AD035D Ver.C IC Bonding Diagram	28

1. 一般規格:

AM9AD003D、AM9AD007D、AM9AD010D、AM9AD014D、AM9AD0176、AM9AD021D、AM9AD024D、AM9AD028D、AM9AD035D，皆爲單晶片 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 LOGPCM 編碼方式，合成長達 3.5、7、10.5、14、17.5、21、24.5、28、35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, OKY/O2)，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). 單一工作電壓範圍爲 2.0 ~ 6.4 伏特(在此範圍內，可採用單一 Rosc 電阻值)。

(2). 語音總長度可達 3.5、7、10.5、14、17.5、21、24.5、28、35秒，且最多可被分割成32個語音段(voice_section)，每段長度可不同。另外每段可以有4個語音段結束點可供選擇使用。

(3). 每一段語音的長度分別最多可達 3.5、7、10.5、14、17.5、21、21、21、21、21秒。(在6kHz取樣頻率下)
每一段 “語音+靜音時間” 的長度，每個母體最多可達 21 秒。(在6kHz取樣頻率下)
每一段語音可編入兩組Sync信號(4個Sync給IO1, O2使用)，可由PowerIO編輯器來做Sync信號編輯。

(4). 共有128個語音格(voice_step)，可規劃成32對語音組(sub_table)，每對語音組是由一個起始語音組(Start sub_table)和一個循環語音組(Loop sub_table)所組成，每個語音組可放的語音格並沒有限制(但最多只有128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O2 的輸出致能或非致能(IO1和O2當作輸出時)。另外在每一語音格中還可以指定一個語音段的結束點(EndMark)，設定Retrigger/Irretrigger轉換(Invert功能)，和進行語音組跳躍(Jumping/Looping功能)。

(5).在每個語音段(語音+靜音)中最多可設定4個語音結束點(EndMark)，可讓使用者在語音格中指定其中一個結束點，語音段播放到此點會停止然後再執行下一個動作。全部共有128個結束點供32個語音段使用(但是AM9AD003D只有64個結束點)，如果配合不同的播放速度，可使用在語音唱歌(Voice Melody)的應用。

(6). 在語音組的最後一個語音格中可設定 “語音組跳躍” 功能(Jumping)，可將現在的語音組(Start sub_table, 例如S1)播完後，接著播放指定的語音組(Loop sub_table, 例如L1)，並可進一步設定這個指定的語音組L1是否要無限循環的播放(Looping)。

(7). 特殊功能選項 ”KeyReleaseJump” (按鍵離開立即跳躍)功能，可以配合Jumping設定來使用，當按鍵一離開，則正在播放的起始語音組S1會立刻停止，並跳到對應的循環語音組L1，而使用者可以配合Looping設定是否要將L1做無限循環的播放。

(8). 在語音格中利用 “Retrigger/Irretrigger 轉換” 功能，可應用在類比指針式的整點報時鐘。另外以特定語音格(voice_step)和語音組(sub_table)的組合，配合”AlarmWithSnooze” 特殊功能選項，可規劃成鬧鐘帶貪睡功能(Alarm Clock with Snooze)的應用。
(*※ 當在Irretrigger模式下且Debounce爲Short時，轉換到Retrigger模式則Debounce會自動變爲Long。其他轉換並不會改變Debounce設定。*)

(9). 內建變頻振盪器，共有16種不同播放速度的選擇(playback speed: 4.1k ~ 15.0kHz)：

A	B	C	D	E	F	G	H
15.0kHz	12.9kHz	11.2kHz	10.0kHz	8.9kHz	8.0kHz	7.4kHz	6.8kHz
I	J	K	L	M	N	O	P
6.3kHz	6.0kHz	5.5kHz	5.2kHz	4.8kHz	4.6kHz	4.3kHz	4.1kHz

(10). IO1或OKY/O2可選擇作輸入腳或是輸出腳 (光罩選擇)。

(11). 可選擇 ”電源啓動(PowerOnPlay)觸發輸入+按鍵觸發輸入模式”(OKY/O2, IO1當作輸入或輸出)，或 “兩鍵觸發輸入模式”(OKY, IO1當作輸入)，或 “單鍵(OKY)觸發輸入模式”(只有OKY當作輸入，IO1當作輸出)。

(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爲 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 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、10M weak-pull low 或 floating 的輸入方式。IO1 輸入可選擇 40K pull-low、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>PowerOnPlay。

(12). IO1可做以下 7 種輸出選擇：

(a). Stop_High pulse : 停止播放時送出高位準脈衝。

(b). Busy_High active : 播放時送出高位準訊號。

(c). Busy_Low active : 播放時送出低位準訊號。

(d). LED 3Hz flash : 播放時 LED 3Hz 閃爍。(當播放速度爲 6kHz 時)

(e). LED 6Hz flash : 播放時 LED 6Hz 閃爍。(當播放速度爲 6kHz 時)

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

(g). Synchronous 輸出 : 可隨聲音作任意的輸出變化(需開啓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。)

(13). O2可做以下 3 種輸出選擇：

(a). Busy_High active : 播放時送出高位準訊號。

(b). Busy_Low active : 播放時送出低位準訊號。

(c). Synchronous 輸出 : 可隨聲音作任意的輸出變化(需開啓PowerIO編輯器來做Sync信號編輯)。

(※ 在IO1和O2同時爲輸出時，當IO1的選項是(a)~(f)，則O2只有(a)~(b)兩種選項；而當IO1的選項是(g)，則O2只有(c)選項。)

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

(15). 每一語音段中的語音長度爲 200HEX 的整數倍 (但是AM9AD003D爲 100HEX 的整數倍)，而每一語音段中的靜音長度爲 80HEX 的整數倍。 但是當"語音+靜音" 的語音段中的語音長度不滿 200HEX，則剩餘的語音長度會當作靜音與後面的靜音合併。

(16). 選擇頻率振盪器：

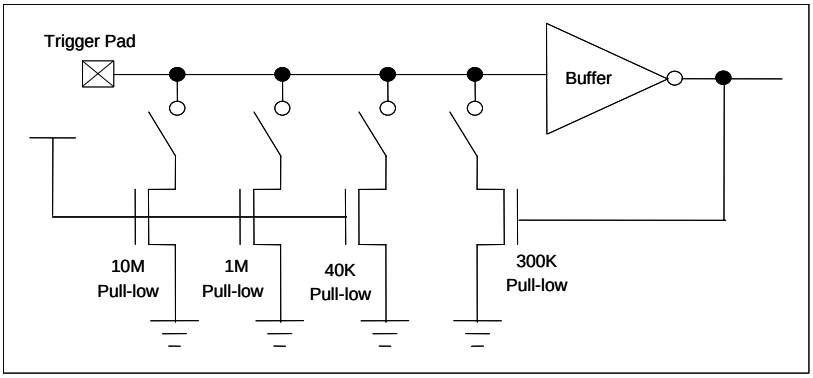
(a). 選擇外部電阻可調式頻率振盪器 : 將 OSC 外接電阻到正電源。

(b). 選擇內建頻率振盪器 : 將 OSC 接地。*(因爲頻飄及系統穩定問題，不建議使用)*

※ 輸入方式選項：

選 項	功 能 描 述
40K pull-low	IC內部爲 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內部爲 1M 的下拉電阻；而當按鍵放開時，IC內部爲 1M+300K (並聯) 的下拉電阻。
CDS	IC內部爲 300K 的下拉電阻，通常與光敏電阻一起使用。
1M pull-low	IC內部爲 1M 的下拉電阻，保留給一些特殊應用使用。
10M pull-low	IC內部爲 10M 的下拉電阻，通常使用在觸控的應用。
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 當輸入時，沒有 10M pull-low 的選項。



1. GENERAL DESCRIPTION

The AM9AD003D, AM9AD007D, AM9AD010D, AM9AD014D, AM9AD0176, AM9AD021D, AM9AD024D, AM9AD028D and AM9AD035D are single-chip voice synthesizing CMOS IC. They are low cost with proper functions and can synthesize voice up to 3.5, 7, 10.5, 14, 17.5, 21, 24.5, 28 and 35 seconds, using Alpha LOGPCM 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, OKY/O2) 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 2.0V to 6.4V (in this range, user can set Rosc as a fixed value).

(2). The total voice duration is about 3.5, 7, 10.5, 14, 17.5, 21, 24.5, 28 and 35 seconds that can be partitioned up to 32 voice_sections. Each voice_section length is flexible. Besides, there are 4 end-address points to select for each voice_sections.

(3). Voice length can be individually up to 3.5, 7, 10.5, 14, 17.5, 21, 21, 21 and 21 seconds, and voice+mute length can be individually up to 21 seconds at 6kHz sample rate for each voice_section. Two pairs of SYNC signal can be edited into each voice by PowerIO editor (4 Syncs for IO1 and O2).

(4). Total 128 voice_steps are available for 32 pairs of sub_table. Each pair consists of one Start sub_table and one Loop sub_table. The number of voice_step for each sub_table is flexible, but maximum is 128. For each voice_step, it can specify one voice_section, playback speed and IO1 and O2 output enable options if IO1 and O2 are set as output. Besides, in voice_step there are also other selections of the EndMark, Retrigger/Irretrigger Invert and Jumping/Looping instruction.

(5). In each voice_section there are maximally 4 EndMark points of voice+Mute and user can specify one EndMark in voice_step. When IC meets the EndMark, it will stop playing voice and execute the next action. There are total 128 EndMarks for 32 voice_sections except AM9AD003D is only 64 EndMarks. If cooperating with different play speed, it can be applied in Voice Melody application.

(6). In last voice_step of sub_table, a “Jumping” instruction is available. Herein you can specify another Loop sub_table (Ex. L1) next to the current sub_table of Start sub_table (Ex. S1) to playback continuously. Then to decide whether L1 sub_table is played in loop or not, i.e. “Looping” instruction.

(7). Using the special “KeyReleaseJump” function with Jumping setup, the playing Start sub_table S1 will stop and immediately play associated Loop sub_table L1 when key is released. User can also set Looping in L1 to play L1 in loop.

(8). In voice_step selected options, the “Retrigger/Irretrigger Invert” function can be applied in Analog Talking Clock application. Through the special “AlarmWithSnooze” function with the combinations of specified voice_steps and sub_tables, user can reach Alarm Clock with Snooze function.

(※ When invert Irretrigger mode with SHORT debounce to Retrigger mode, the debounce will be changed to LONG automatically. For other cases, the debounce time is not changed.)

(9). Built-in variable oscillator, 16 kinds of playback speed option : (4.1k ~ 15.0kHz)

A	B	C	D	E	F	G	H
15.0kHz	12.9kHz	11.2kHz	10.0kHz	8.9kHz	8.0kHz	7.4kHz	6.8kHz
I	J	K	L	M	N	O	P
6.3kHz	6.0kHz	5.5kHz	5.2kHz	4.8kHz	4.6kHz	4.3kHz	4.1kHz

(10). IO1 or OKY/O2 can be either input or output pin (Mask option).

(11). Optional "PowerOnPlay + other Trigger Input" (OKY/O2 and IO1 are input or output), "Two Triggers Input" (OKY and IO1 are input), or "One Triggers Input" (OKY is input, O2 is output).

(a). Each input pin has mask options for Edge/Level, Hold/Unhold and Retrigger/Irritrigger 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). OKY input can choose Toggle On/Off function or not.

(d). OKY input can choose 40K pull-low, CDS+1M、CDS、1M pull-low、10M pull low or floating input type. IO1 input can choose 40k pull-low, 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 > PowerOnPlay.

(12). IO1 has 7 kinds of output option :

(a). Stop_High pulse : high active stop pulse output whenever device stop playing.

(b). Busy_High active : high active signal output during playing.

(c). Busy_Low active : low active signal output during playing.

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

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

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

(g). Synchronous output : arbitrary output with voice, user can edit the Sync signal by PowerIO editor.

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

(13). O2 has 3 kinds of output option :

(a). Busy_High active : high active signal output during playing.

(b). Busy_Low active : low active signal output during playing.

(c). Synchronous output : arbitrary output with voice, user can edit the Sync signal by PowerIO editor.

(※ When both IO1 and O2 are in output status, O2 can only select (a)~(b) if IO1 output option is (a)~(f), O2 can only select (c) if IO1 output option is (g).)

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

(15). The voice length in voice_section must be the multiple of 200HEX except AM9AD003D is the multiple of 100HEX, and the mute length in voice_section must be the multiple of 80Hex. But when the voice length in voice_section of "voice + mute" don't fully use the last 200Hex, the unused voice length is set as mute and combined with the followed mute time.

(16). Oscillator selection:

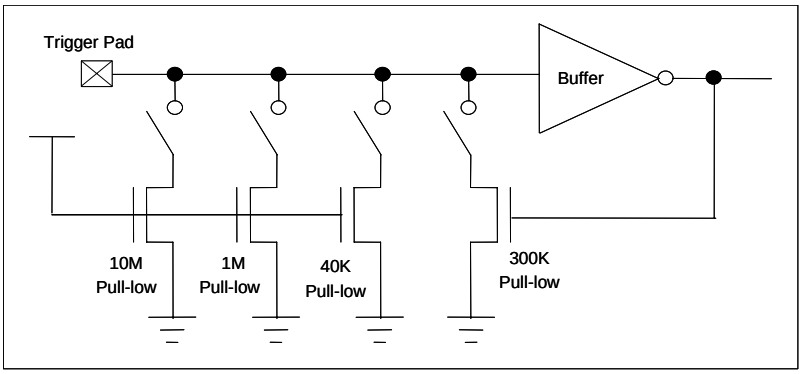
(a). External oscillator: Connect OSC pin to Vdd with a resistor, Rosc.

(b). Internal oscillator: Connect OSC pin to GND. *(Not suggested because of frequency shift and stability)*

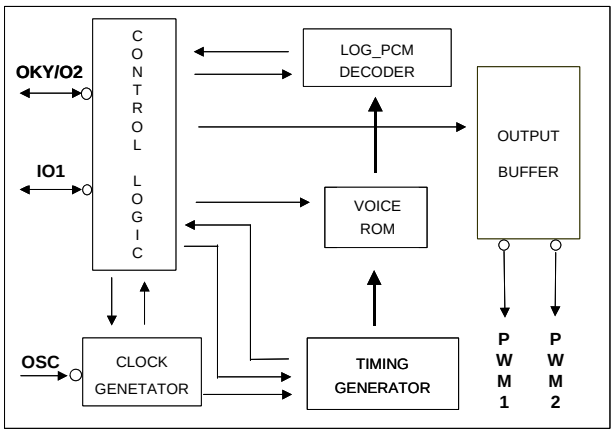
※Input Type Description:

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.
10M pull-low	Internal 10M ohms weak pull-low, usually for touching trigger.
Floating	No internal resistor connection, usually connected to other output pin or connected to GND by an external resistor.

* 10M pull-low option is not available for IO1 input.



3. BLOCK DIAGRAM



4. PAD DESCRIPTION

Pad Name	Pad No.	ATTR.	Function
IO1	1	I/O	Status output or input for trigger.
VDD1, 2	2, 8	Power	Positive power supply.
OKY/O2	3	I/O	Status output or input for trigger.
OSC	4	I	Oscillator input. For using internal oscillator, connect OSC to GND.
GND	5	Power	Negative 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 AM9AA_DB demo board to demonstrate the AM9AD function. The related mapping of AM9AA_DB is as following,

	AM9AD	AM9AA_DB	AM9AA_DB Description
I/O Pin	OKY/O2	OKY	OKY performs OKY/O2 input or output.
	IO1	IO1	The same.
	PWM1, PWM2	PWM1, PWM2	PWM output to directly drive speaker.
	OSC	Rosc	Rosc is connected with 160K ohms resistor.

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

	AM9AD	AM9AA_DB	AM9AA_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.
	10M pull-low	10M 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.

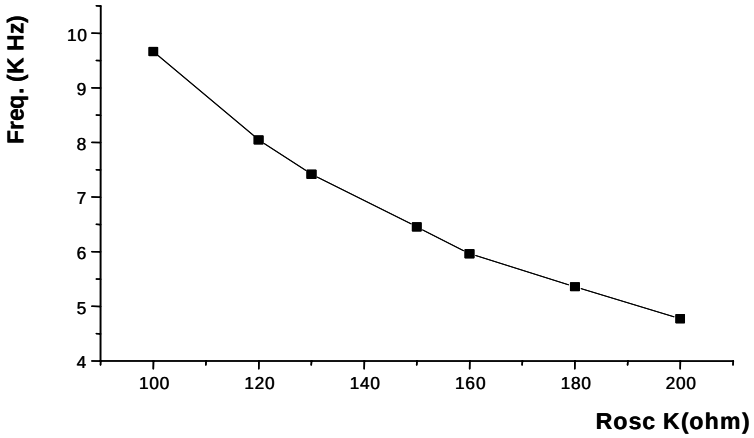
6. ABSOLUTE MAXIMUM RATING

Symbol	Rating	Unit
V_{dd}~V_{ss}	-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	°C
T_{st} (storage)	-25 ~ +85	°C

7. DC CHARBDTERISTICS

Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
V_{dd}	Operating voltage		2.0	3.0	6.4	V	
I_{sb}	Supply current	Standby			1	uA	V_{dd}=3V, 6kHz S.R., no load
I_{op}		Operating		700			
I_{ih}	Input current: OKY/O2 (40K pull low)				100	uA	V_{dd}=3V
I_{il}				0			
I_{ih}	Input current: OKY/O2, IO1 (1M pull low)				3	uA	V_{dd}=3V
I_{il}				0			
I_{ih}	Input current: OKY/O2 (10M pull low)				0.3	uA	V_{dd}=3V
I_{il}				0			
I_{ih}	Input current: OKY/O2, IO1 (CDS)				10	uA	V_{dd}=3V
I_{il}				0			
I_{oh}	PWM output current			-30		mA	V_{dd}=3V, V_{oh}=2.4V
I_{ol}				30			V_{dd}=3V, V_{ol}=0.6V
I_{oh}	IO1/O2 output current			-4.6		mA	V_{dd}=3V, V_{oh}=0.46V
I_{ol}				9			V_{dd}=3V, V_{ol}=2.1V
dF/F	Frequency stability		-5		5	%	$\frac{F_{osc}(3v)-F_{osc}(2.4v)}{F_{osc}(3v)}$
dF/F	F_{osc} lot variation		-10		10	%	V_{dd}=3V, R_{osc}=160KΩ

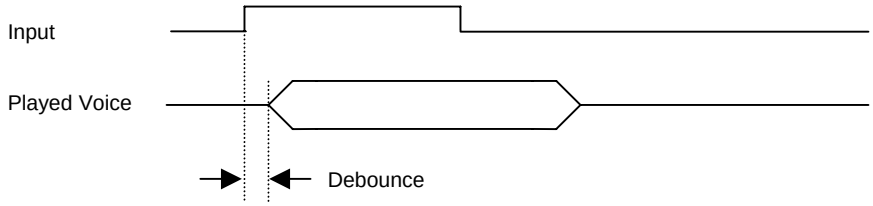
8. Frequency vs. External Rosc (measured at internal option of 6kHz playback speed)



9. TIMING DIAGRAM

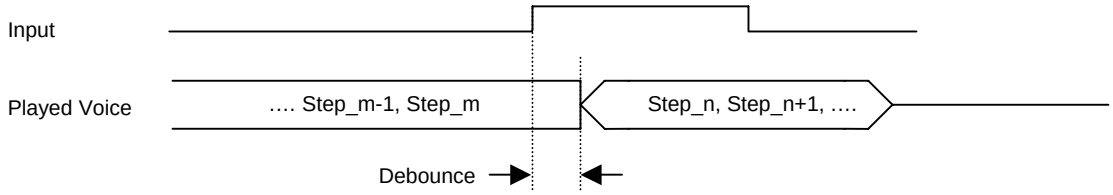
(1) Debounce Time

(a). Trigger while no playing voice



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

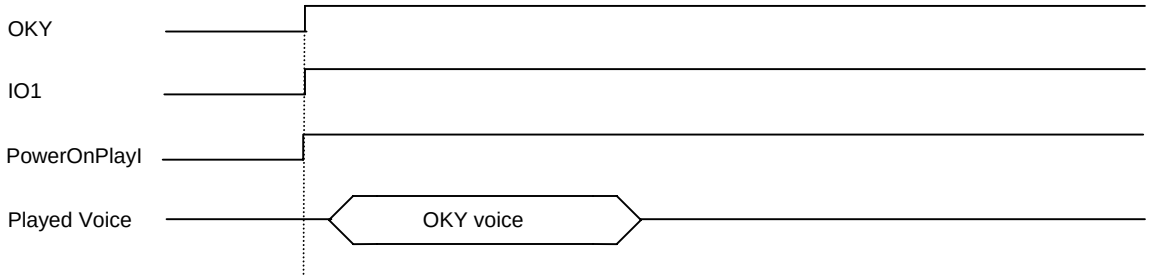
(b). Trigger While playing voice



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

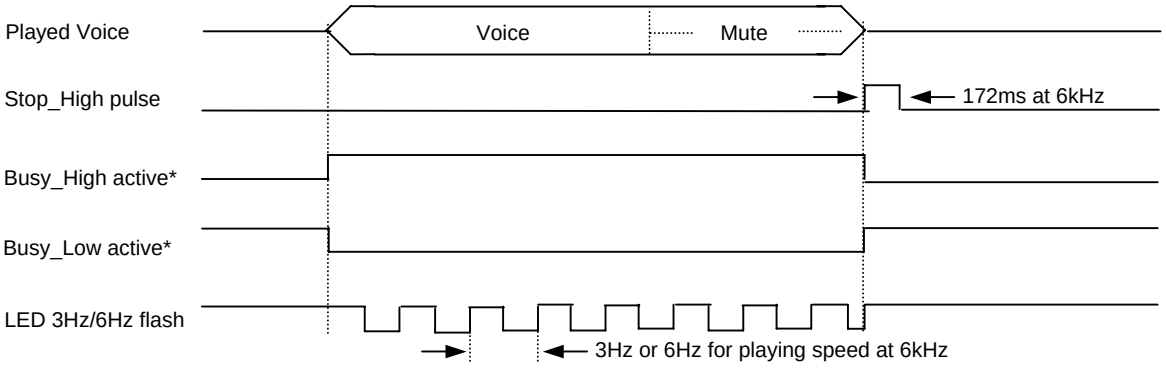
For example, if Step_m S.R. = 8kHz, Slow debounce = 20*(6k/8k) ms = 15ms, Fast debounce < 50*(6k/8k) us =37.5us

(2) Input Priority



※ Priority: OKY > IO1 > PlayOnPlay

(3) Status Output (IO1 & O2)

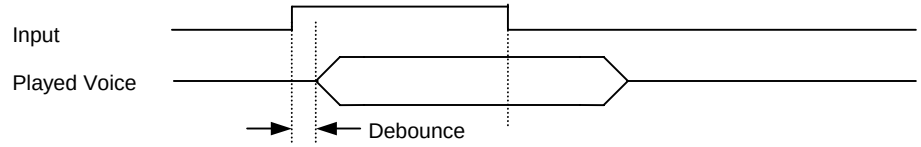


LED dynamic 2/4: When the voice amplitude is higher than 2/4 full-scale amplitude, LED will be ON, i.e. status output is low.

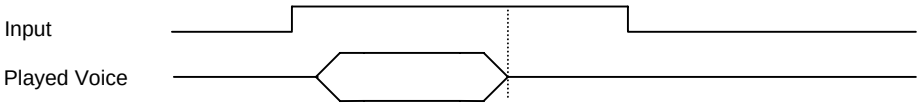
* O2 can only choose Busy_High active or Busy_Low active.

(4) General Timing Diagram

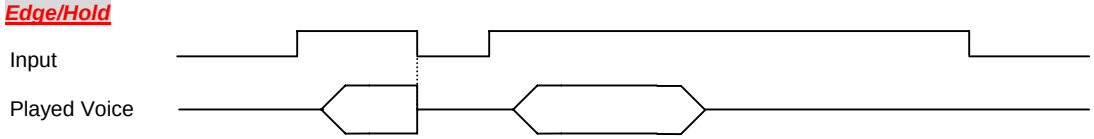
(a). Edge mode, Edge trigger



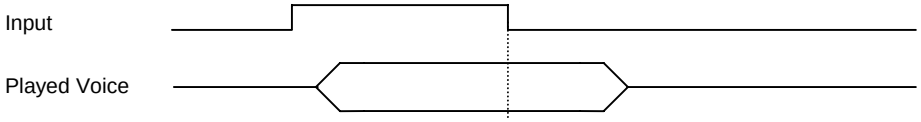
(b). Edge mode, Level trigger



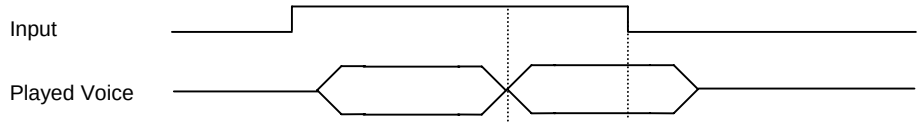
Edge/Hold



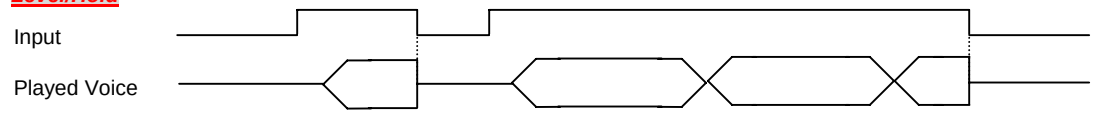
(c). Level mode, Edge trigger



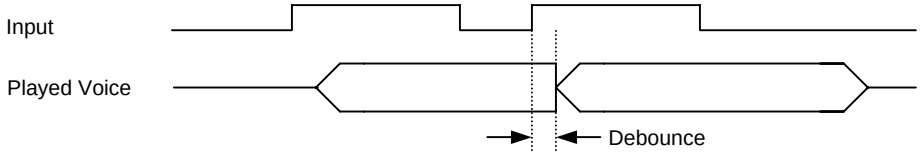
(d). Level mode, Level trigger



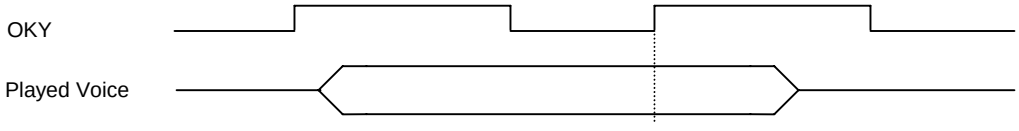
Level/Hold



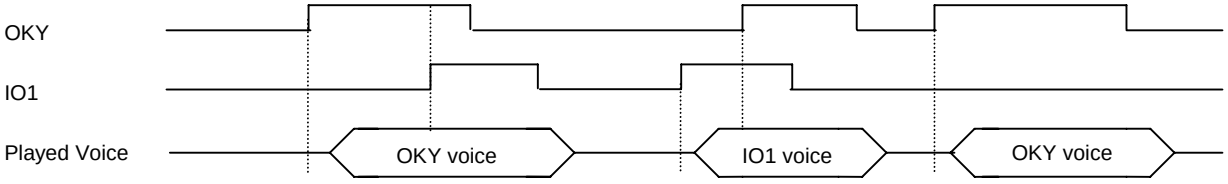
(e). Retrigger mode



(f). Irretrigger mode



(g). Retrigger mode, first key priority

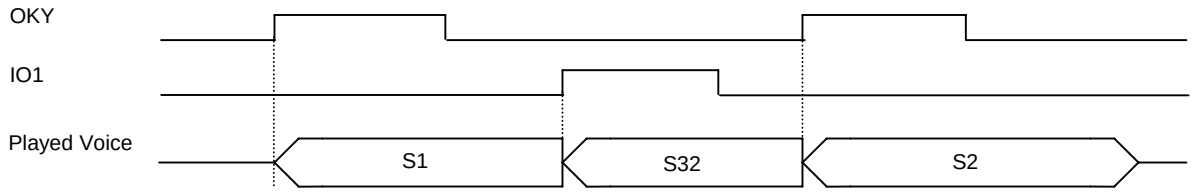


(5) Special Timing Diagram

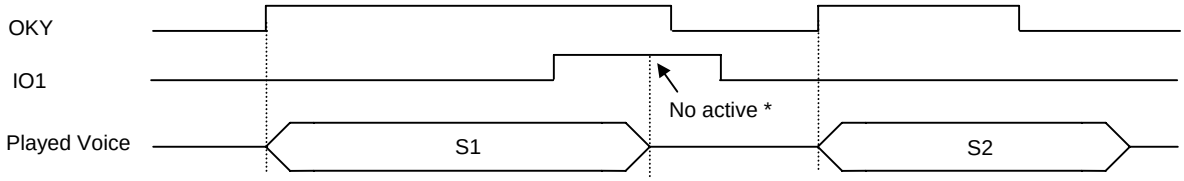
Henceforth, the debounce time is ignored for the following diagrams.

(a). Different Input Reload *(No Jumping and Looping function exist.)*

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

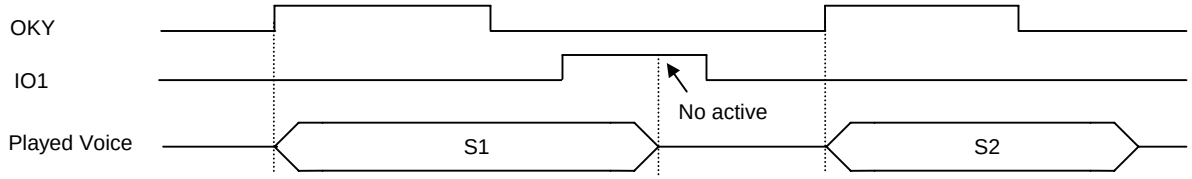


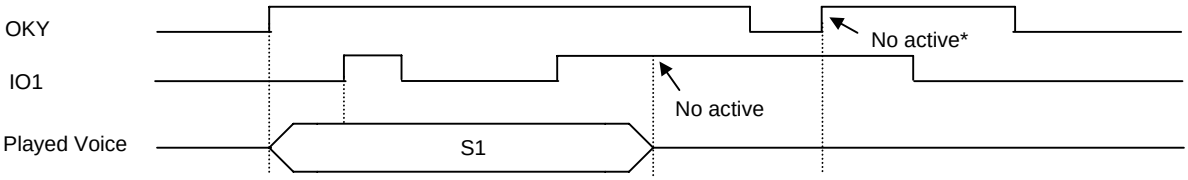
(a-2) OKY (E/U/R) =S1 S2 S3 S4, IO1 (L/x/x) =S32



* If you press IO1 during OKY voice playing, in the time of S1 end, the trigger mode follows OKY (E/U/R).

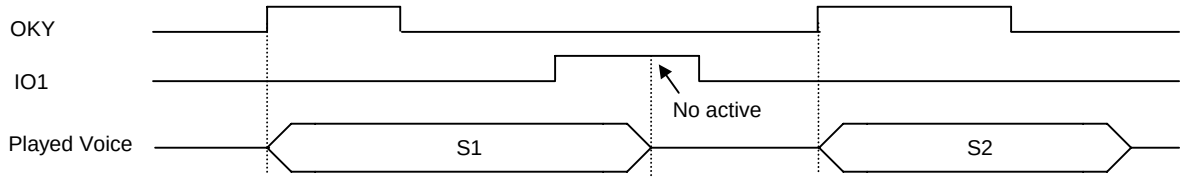
(a-3) OKY (E/U/I) =S1 S2 S3 S4, IO1 (E/x/x) =S32



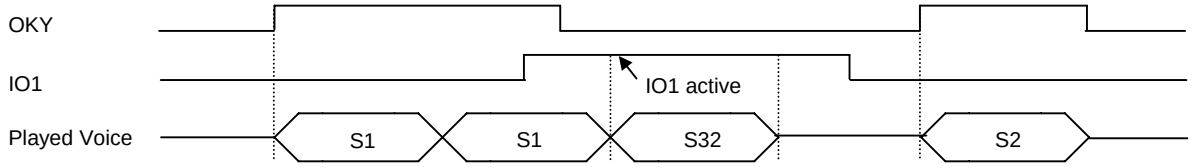


* Because IO1 signal is still high, the OKY Edge signal is not active.

(a-4) OKY (E/U/I) =S1 S2 S3 S4, IO1 (L/x/x) =S32



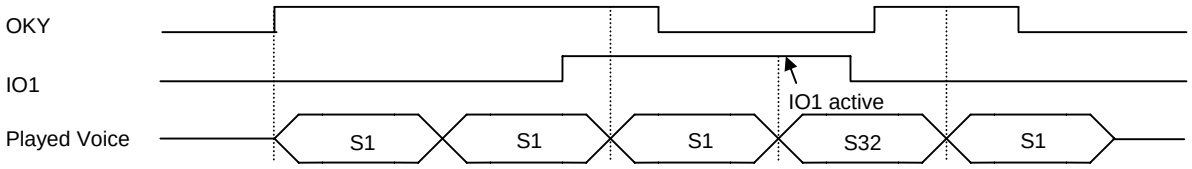
(a-5) OKY (L/U/x) =S1 S2 S3 S4, IO1 (E/x/x) =S32



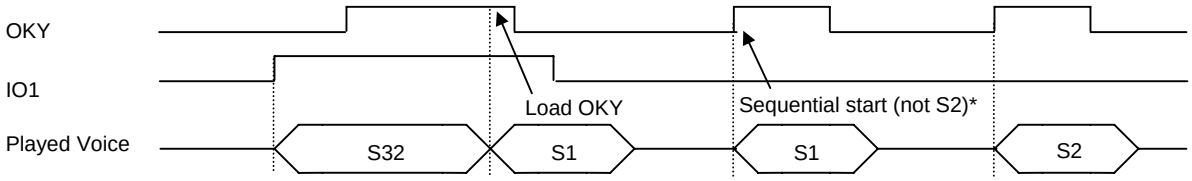
※ In the time of sub_table end: When S1 end, the trigger mode follows OKY (L/U/x). When S32 end, it follows IO1 (E/x/x).

※ Once S32 is played (just leave S1 ending), the trigger mode follows IO1 (E/x/x) immediately.

(a-6) OKY (L/U/x) =S1 S2 S3 S4, IO1 (L/U/x) =S32



※ Reload key priority: OKY > IO1

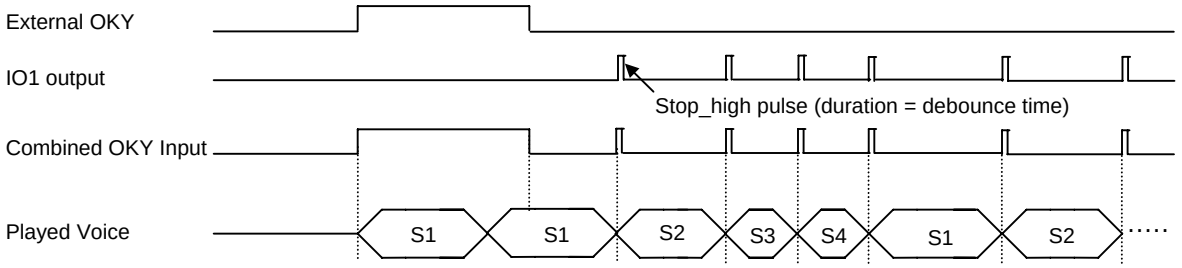


※ When IO1 is triggered first and its voice play, to trigger OKY don't follow sequential trigger because no debounce happen.

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

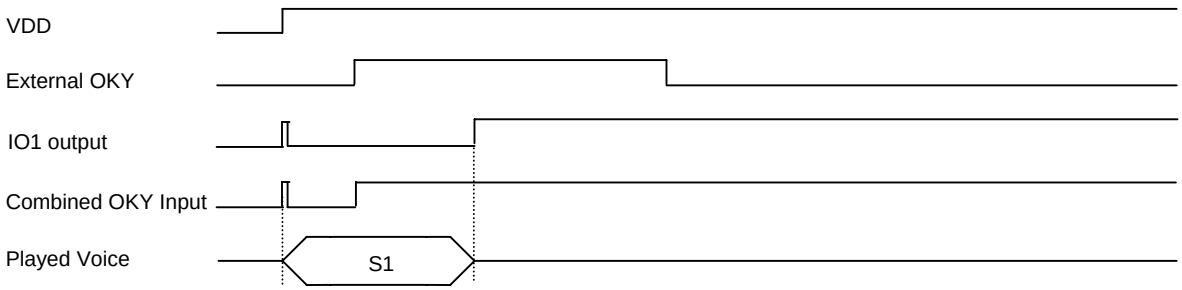
(b). External Feedback function *(IO1 is output and connected to OKY input)*

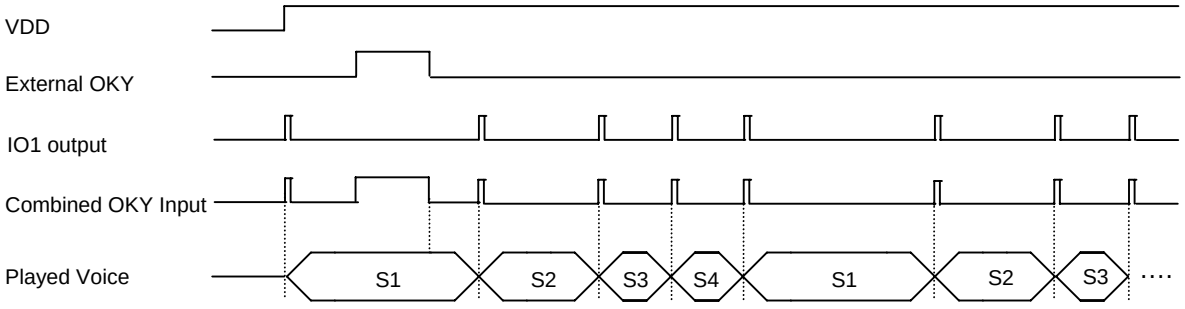
(b-1) OKY (L/U/I) =S1 S2 S3 S4, IO1=Stop_high pulse (When voice end, IO1 shows a high pulse)



※ The duration of Stop_high pulse is 170ms at 6kHz SR, but the high signal will trigger voice and turn low after debounce.

(b-2) OKY (E/U/I) =S1 S2 S3 S4, IO1= Busy_low (When not playing voice, IO1 is high.)



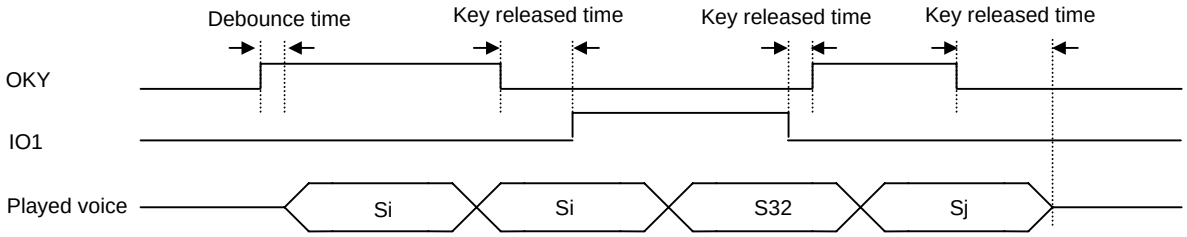


※ When power is on, IO1 will generate a high pulse at Busy_low status, but the duration equal debounce time.

(c). Random Function

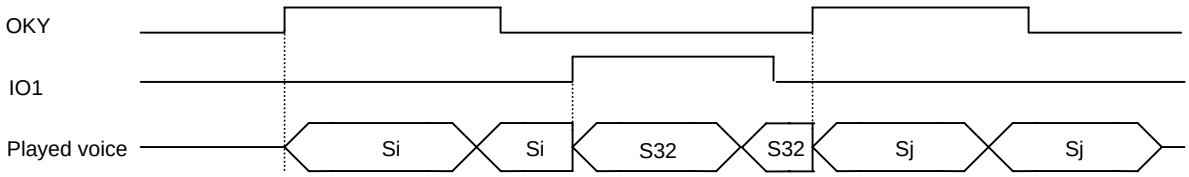
(c-1) OKY (L/U/I) =S1 S2 S3 S4, IO1 (L/U/I) =S32

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”.



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

(c-2) OKY (L/U/R) =S1 S2 S3 S4, IO1 (L/U/R) =S32

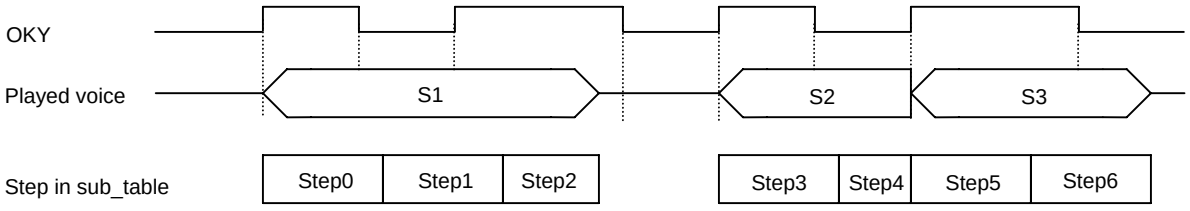


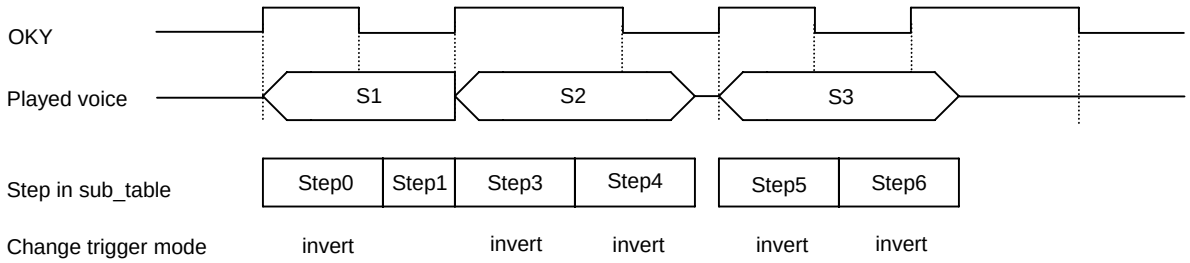
i=1 or 2 or 3 or 4; j=1 or 2 or 3 or 4 (i and j are random number)

(d). Change the Trigger mode while playing voice (Invert Retrigger/Irretrigger function in voice_step)

Use Invert function can change the Retrigger mode to Irretrigger mode or change the Irretrigger mode to Retrigger in each voice_step of sub_table.

OKY (E/U/R) = S1 S2 S3, (S1= step0 + step1 + step2, S2= step3 + step4, S3= step5 + step6)





※ A special setting for Analog Talking Clock application: If the step is Irretriggger and short debounce, inverting the trigger mode to retrigger will change the debounce time to long. (For other cases, the debounce will be not changed.)

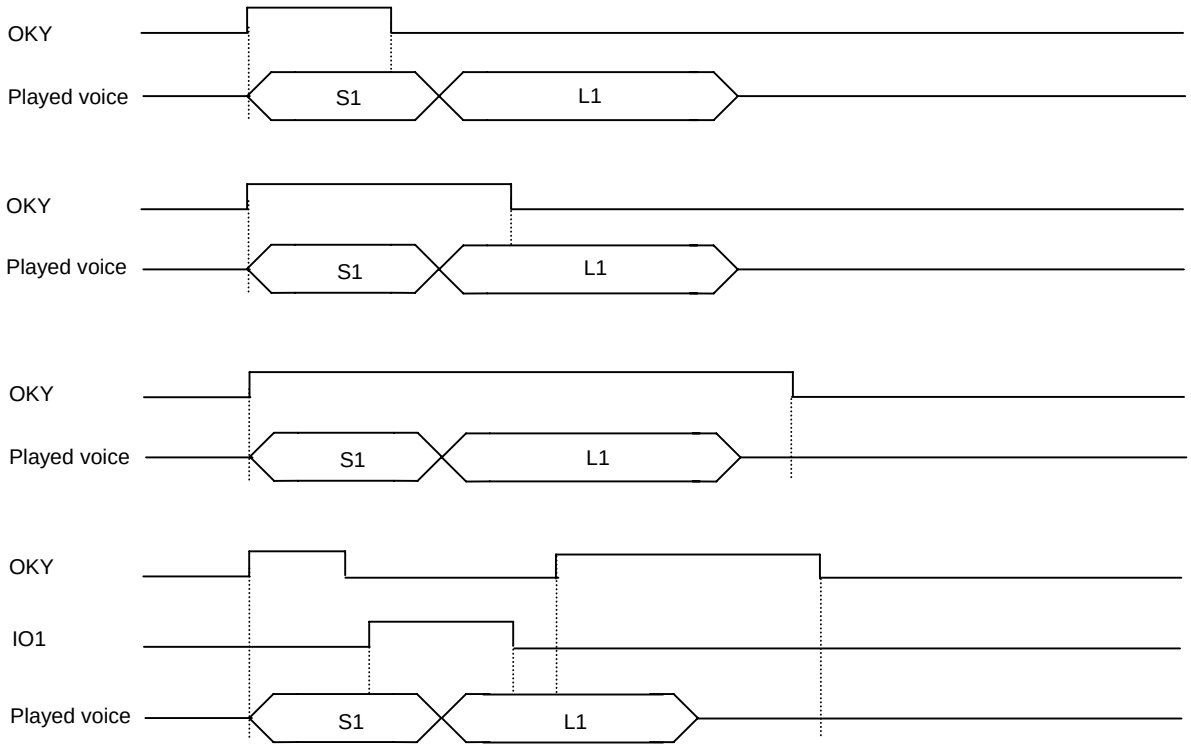
(6) Jumping and Looping Function

In the end of any Start sub_table, you can set a Jump instruction and indicates the associated Loop sub_table for Jumping function. If you do, when 1st Start sub_table is end, IC will detect the instruction and the 2nd Loop sub_table will be played immediately and automatically. In Loop sub_table, you can also set a Loop instruction for self-looping function.

(In Jumping and Looping function, "Different Input Reload" function in (4-a) doesn't work.)

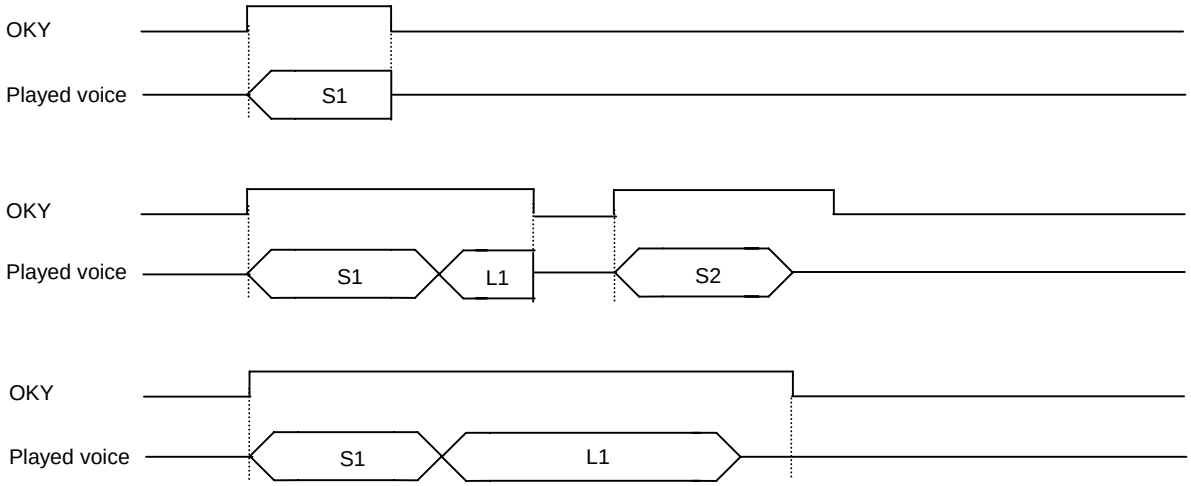
(a). If S1 is set Jumping without Looping

(a-1) OKY (E/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32 (L1 means the Jumping sub_table of S1)

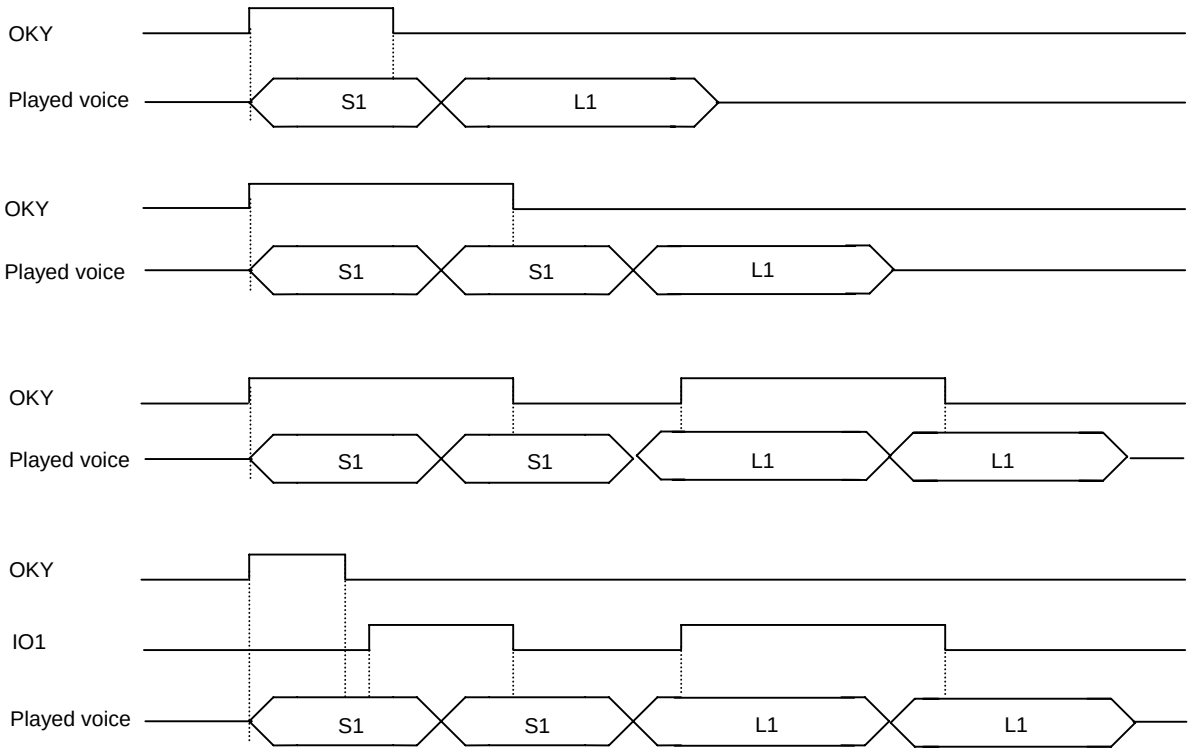


※ While playing OKY's voice (S1 or L1), to trigger OKY or IO1 is not active at Edge/Irretrigger mode.

(a-2) OKY (E/H/x) =S1 L1 S2 S3

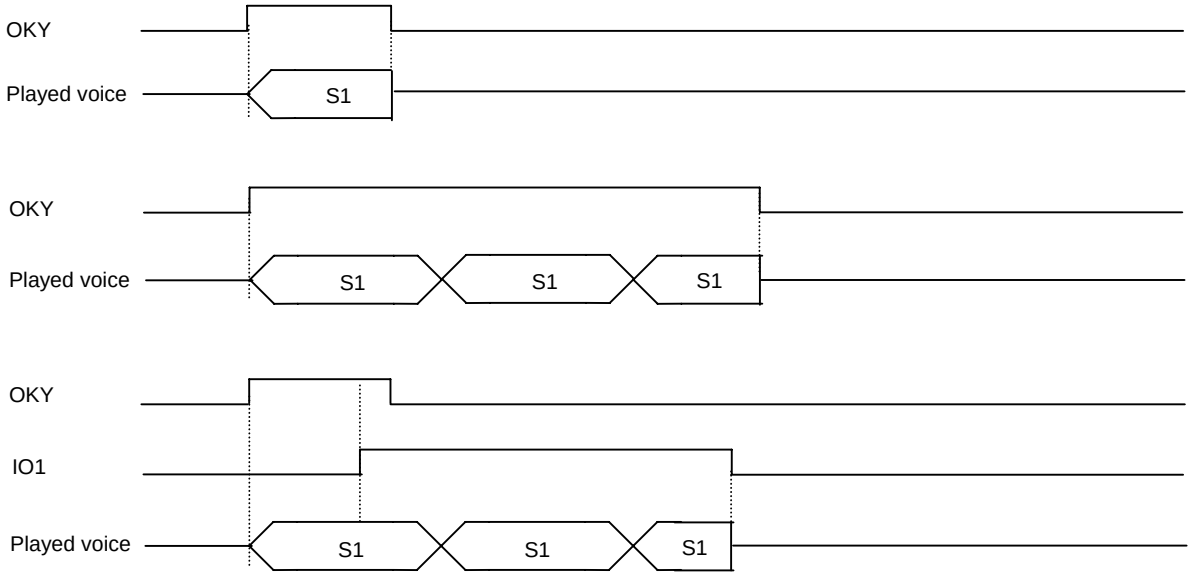


(a-3) OKY (L/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32



※ Without Different Input Reload, while playing OKY's voice, to trigger IO1 is recognized as to trigger OKY.

(a-4) OKY (L/H/x) =S1 L1 S2 S3, IO1 (x/x/x) = S32

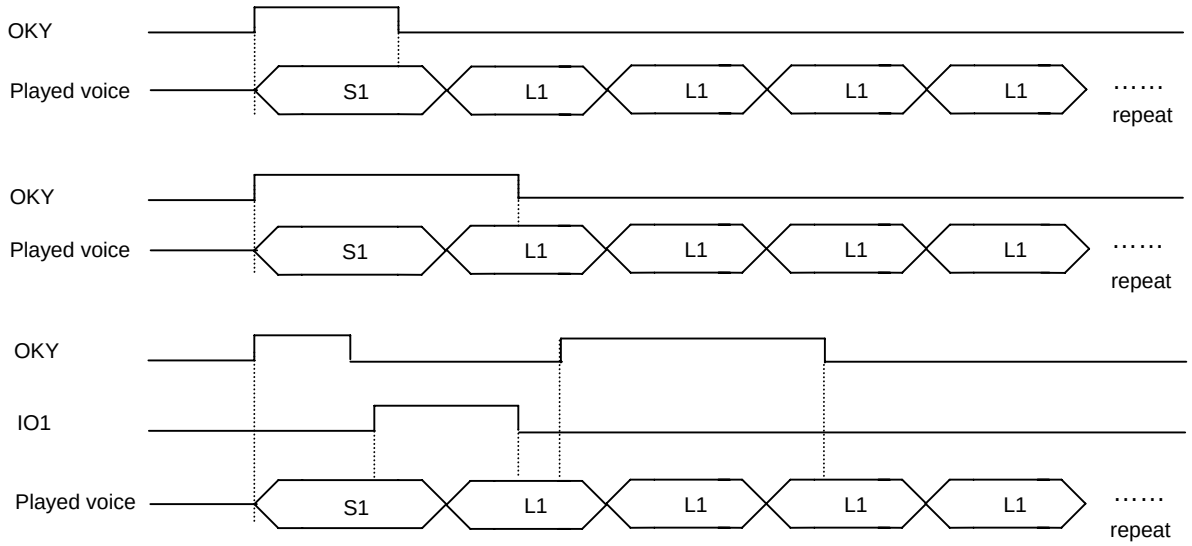


※ Without Different Input Reload, while playing OKY's voice, to trigger IO1 is recognized as to trigger OKY.

(b). If S1 is set Jumping with Looping

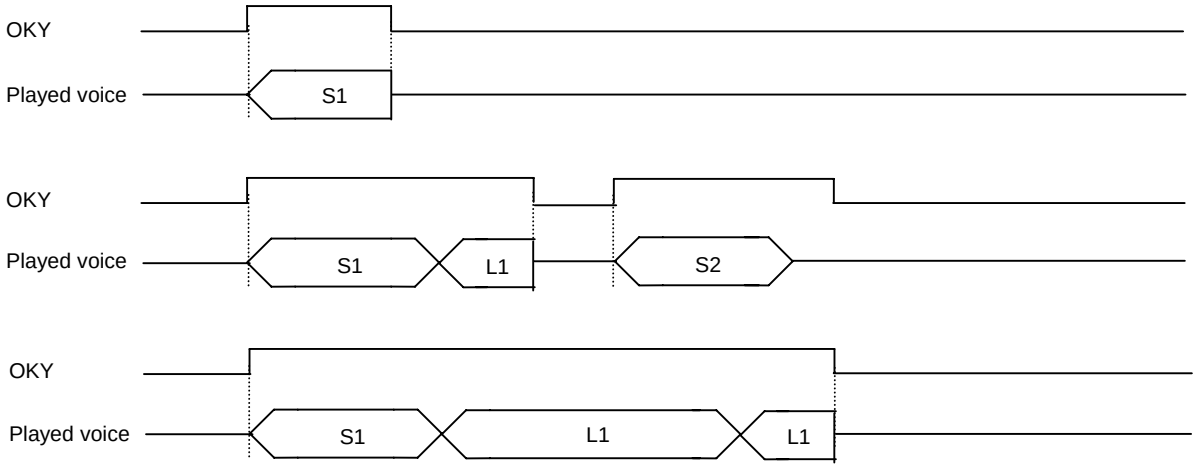
The timing diagram is similar with (5-a) “Jumping without Looping” except the last self-looping.

(b-1) OKY (E/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32

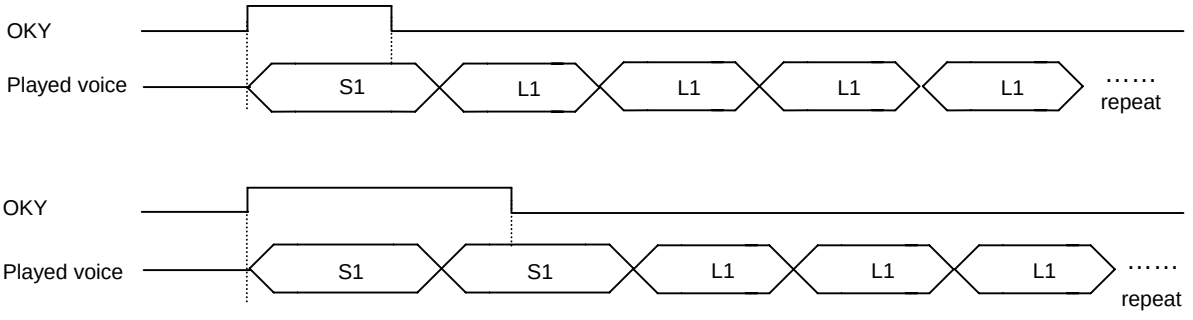


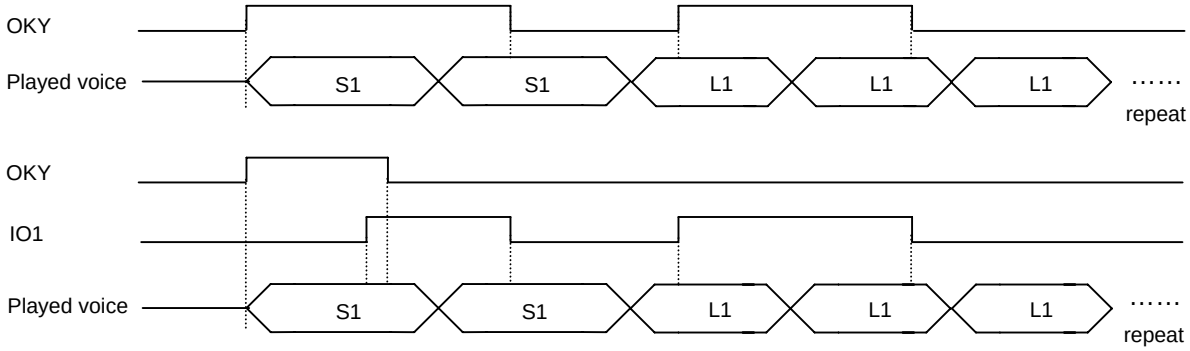
※ While playing OKY’s voice (S1 or L1), to trigger OKY or IO1 is not active at Edge/Irretrigger mode.

(b-2) OKY (E/H/x) =S1 L1 S2 S3



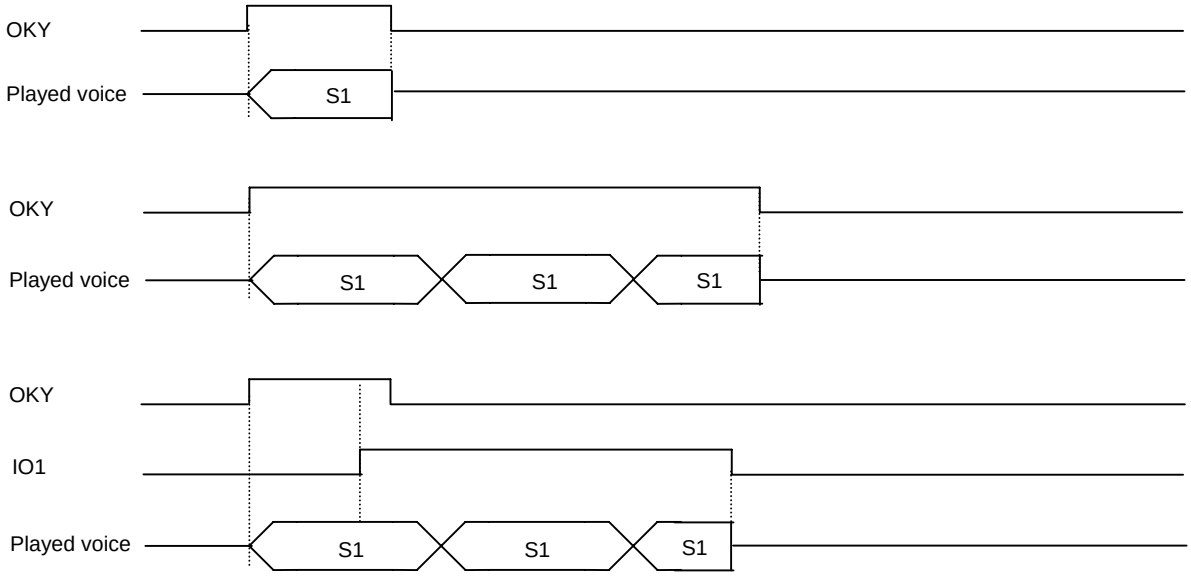
(b-3) OKY (L/U/I) =S1 L1 S2 S3





※ While playing OKY's voice, to trigger IO1 is recognized as to trigger OKY. Reload function doesn't work.

(b-4) OKY (L/H/x) =S1 L1 S2 S3, IO1 (x/x/x) = S32

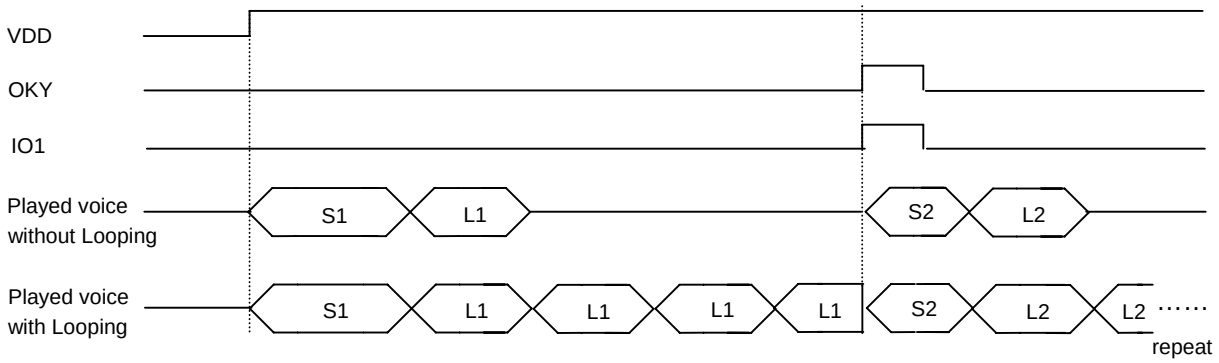


※ Without Different Input Reload, while playing OKY's voice, to trigger IO1 is recognized as to trigger OKY.

(c). PowerOnPlay with Jumping and Looping or without Looping

The trigger mode of PowerOnPlay is fixed as E/U/R, other trigger signal will stop PowerOnPlay's voice immediately and play the interrupted trigger's voice no matter what condition is Reload or Jumping.

PowerOnPlay (E/U/R) =S1 L1, OKY (x/U/I) = S2 L2, IO1 = S3 L3



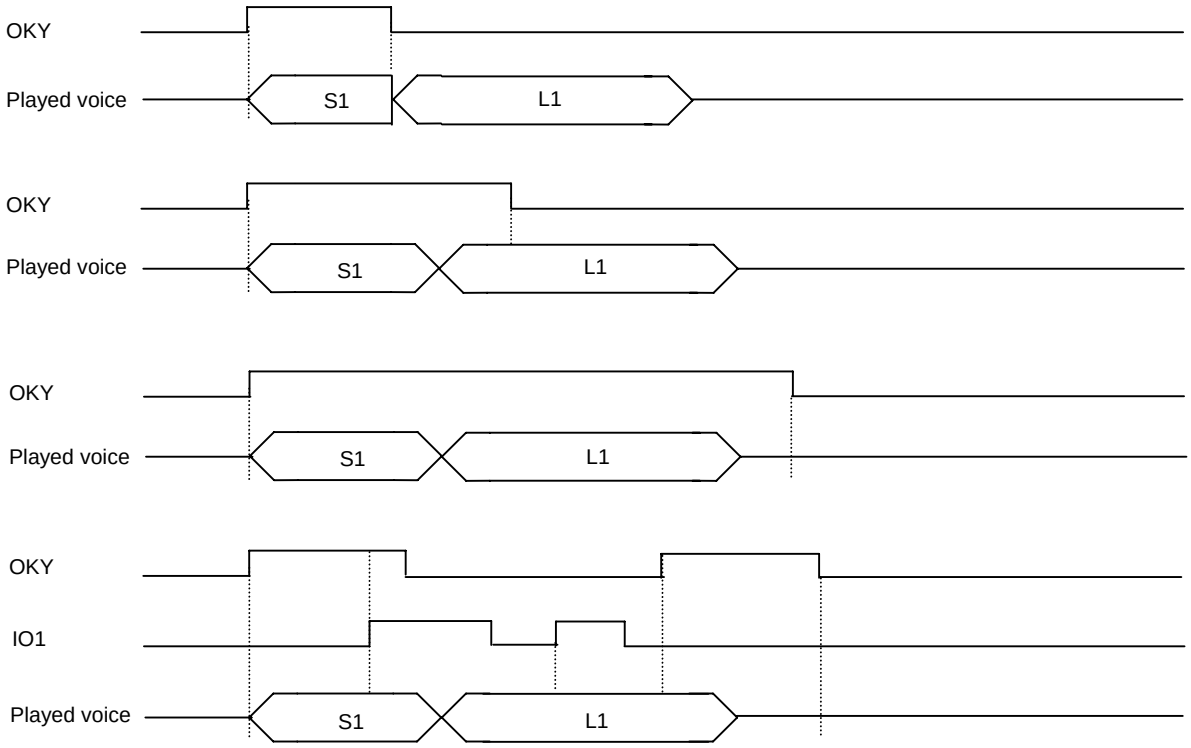
※ Priority: OKY > IO1 > PowerOnPlay

(7) KeyReleaseJump function

KeyReleaseJump is a combined function of Hold and Jumping. It is a special setting, when trigger is released, the voice immediately stop and jump to Jumping sub_table. When tick this option, all input pins are in KeyReleaseJump condition.

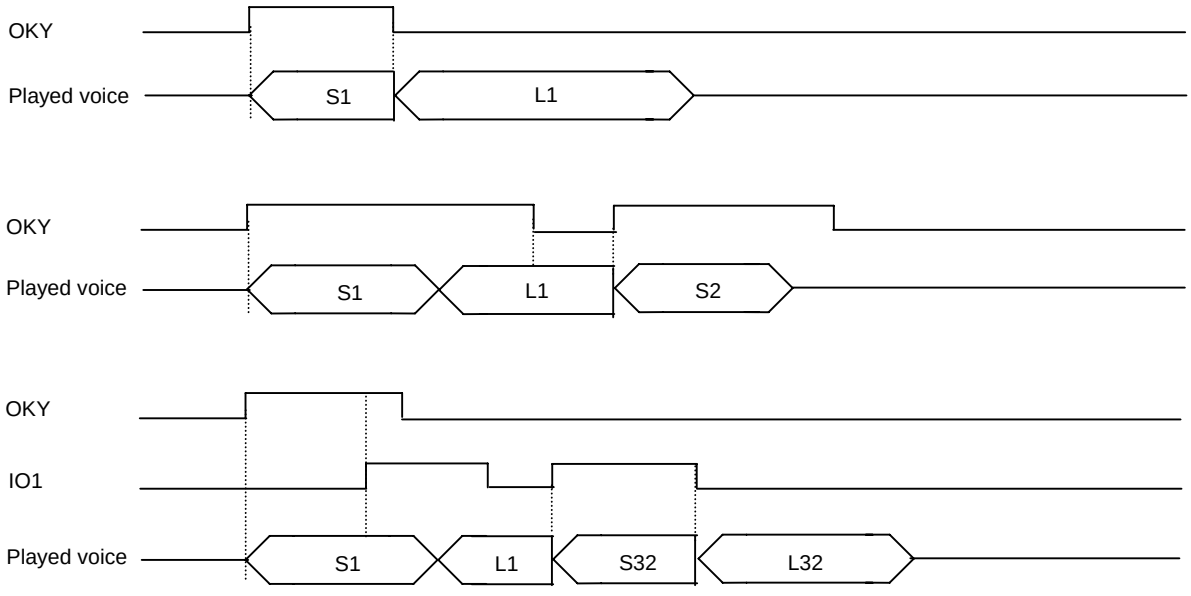
(a). KeyReleaseJump with Jumping and without Looping

(a-1) OKY (E/x/l) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L32 (L1 means the Jumping sub_table of S1)



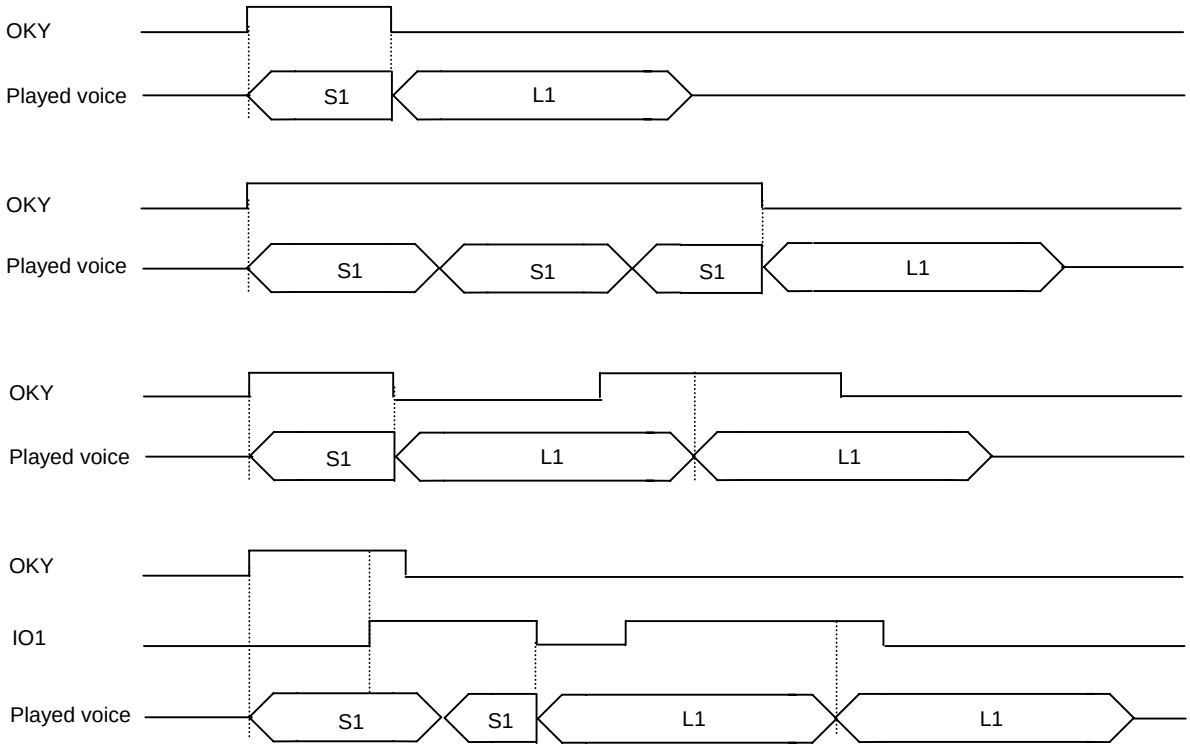
※ While playing OKY's voice (S1 or L1), to trigger OKY or IO1 is not active at Edge/Irretrigger mode.

(a-2) OKY (E/x/R) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L32



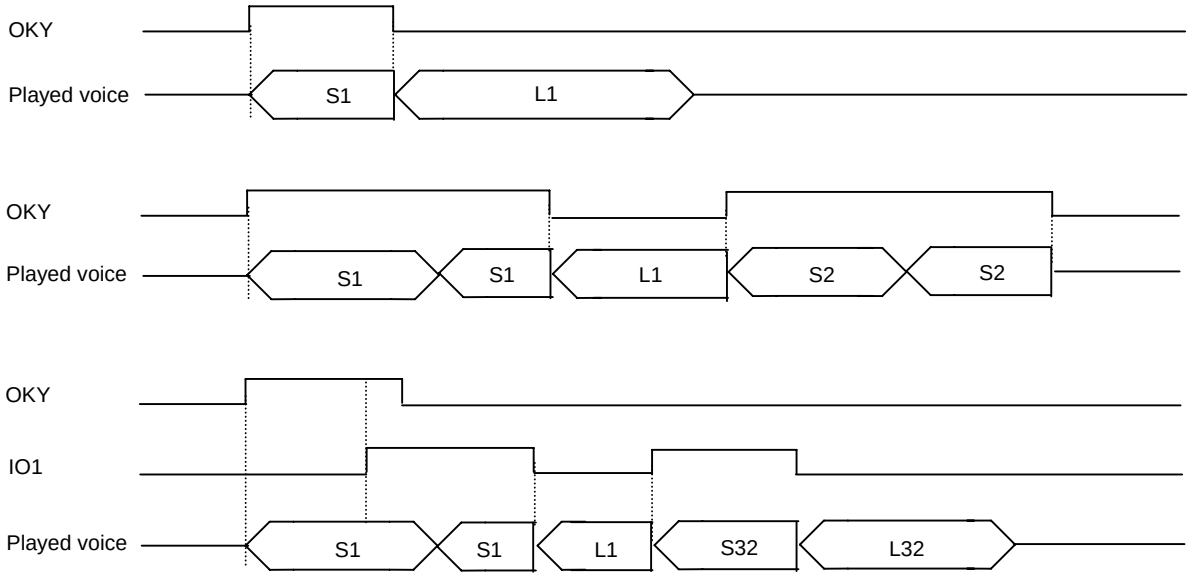
※ While playing OKY's Looping voice (L1, key is released), to trigger OKY or IO1 is active at Retrigger mode.

(a-3) OKY (L/x/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L32



※ While playing OKY's voice (S1 or L1), to trigger IO1 is recognized as to trigger OKY.

(a-4) OKY (L/x/R) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L32

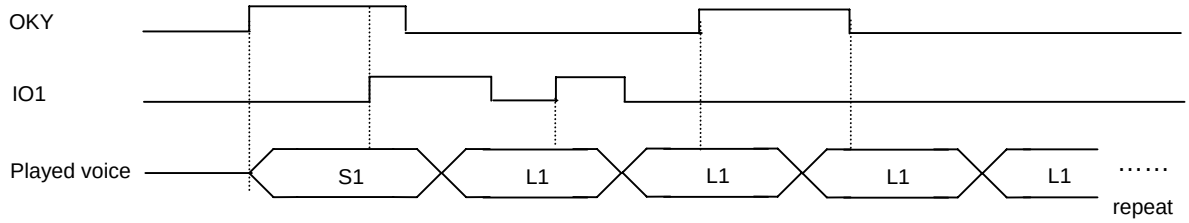


※ While playing OKY's Looping voice (L1, key is released), to trigger OKY or IO1 is active at Retrigger mode.

(b). KeyReleaseJump with Jumping and Looping

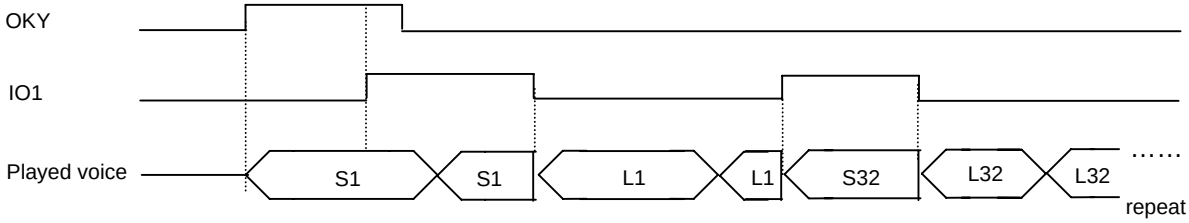
The timing diagrams are similar with (6-a.) “Jumping Without Looping” except the last self-looping.

(a-1) OKY (E/x/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L32 (L1 & L32 are set Looping)



※ While playing OKY’s voice (S1 or L1), to trigger OKY or IO1 is not active at Edge/Irretrigger mode.

(a-2) OKY (L/x/R) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L32 (L1 & L32 are set Looping)

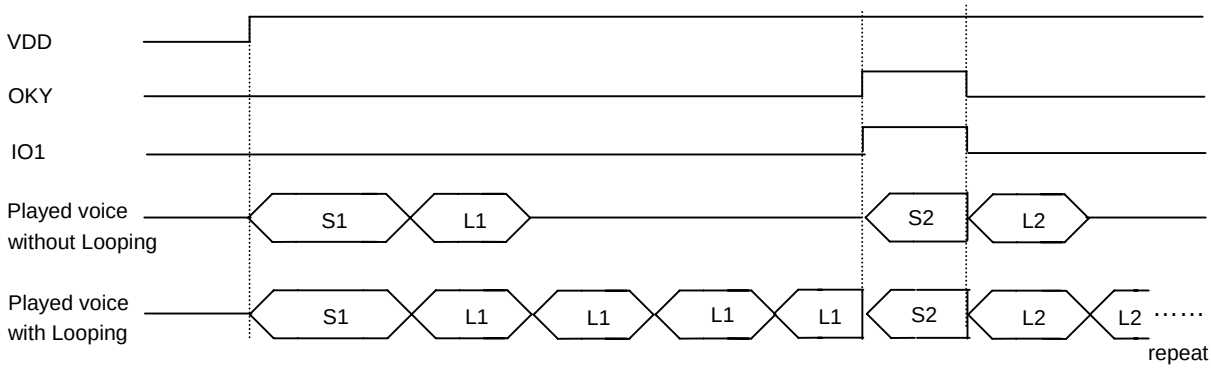


※ While playing OKY’s Looping voice (L1, key is released), to trigger OKY or IO1 is active at Retrigger mode.

(C). PowerOnPlay with KeyReleaseJump

The trigger mode of PowerOnPlay is fixed as E/U/R, other trigger signal will stop PowerOnPlay’s voice immediately and play the interrupted trigger’s voice no matter what condition is Reload or Jumping.

PowerOnPlay (E/U/R) =S1 L1, OKY (x/U/I) = S2 L2, IO1 = S3 L3



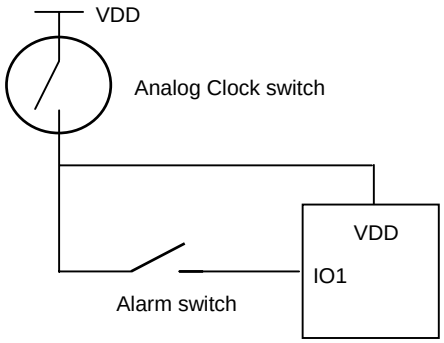
※ Priority: OKY > IO1 > PowerOnPlay

(8) Alarm Clock application

There are 2 kinds of Alarm application: Alarm without snooze and Alarm with snooze.

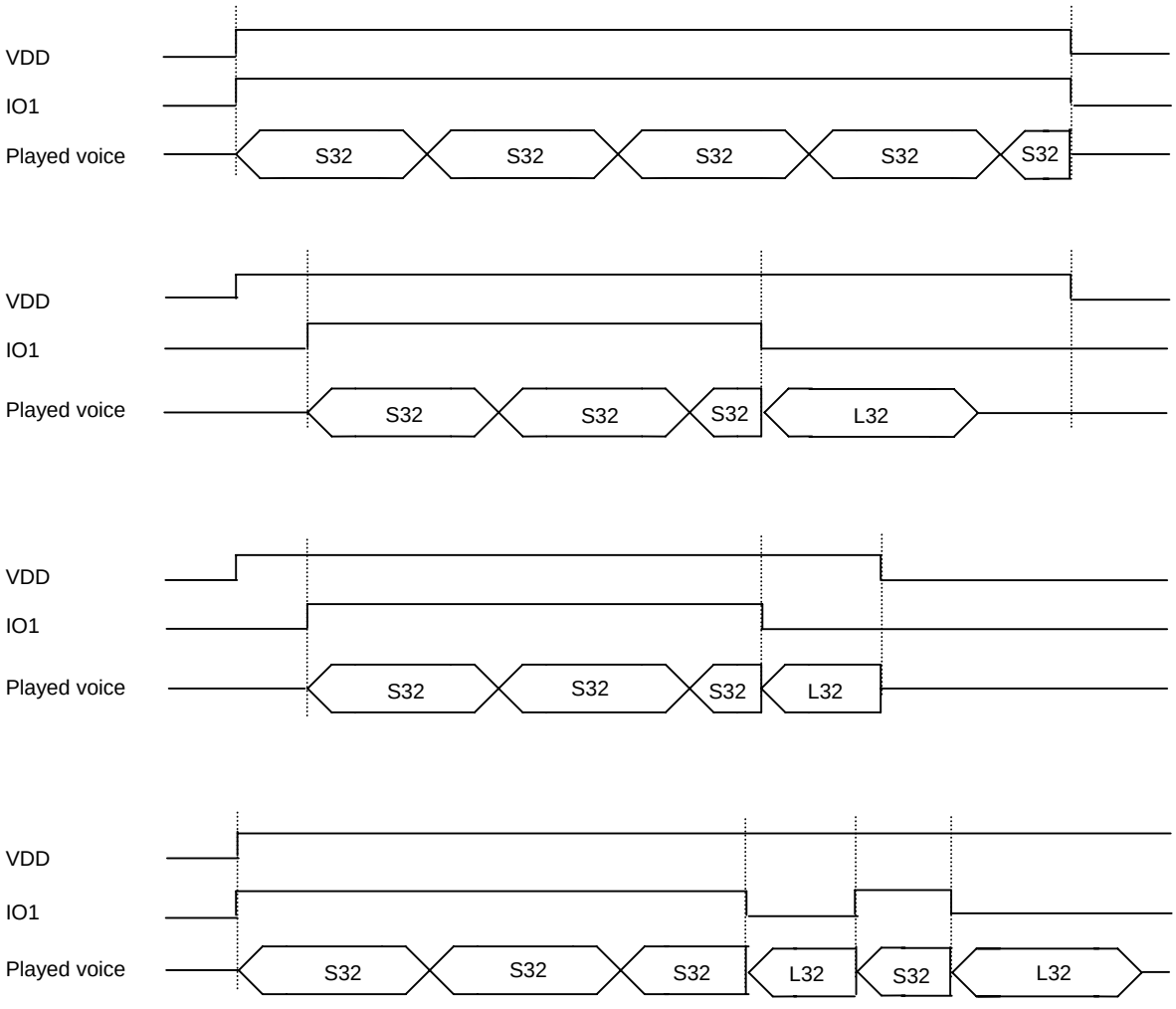
(a). Alarm clock without Snooze

Alarm without snooze is one of KeyReleaseJump application.



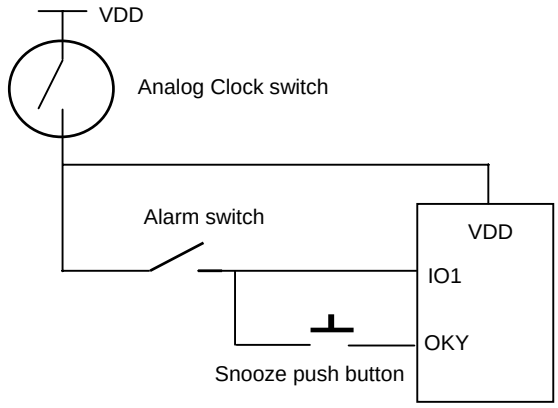
KeyReleaseJump function is set.

IO1 (L/x/R) =S32 L32, long debounce (L32 is for Jumping, usually play greeting voice)



(b). Alarm clock with Snooze (AlarmWithSnooze Function)

AlarmWithSnooze is a very special design that consists of parts of KeyReleaseJump, Different Input Reload and Jumping/Looping. When this function is enabled, nearly all IC logics will be changed. Thus, please refer to the explanation in the following timing diagrams or contact Alpha for more detail if you need to do so.

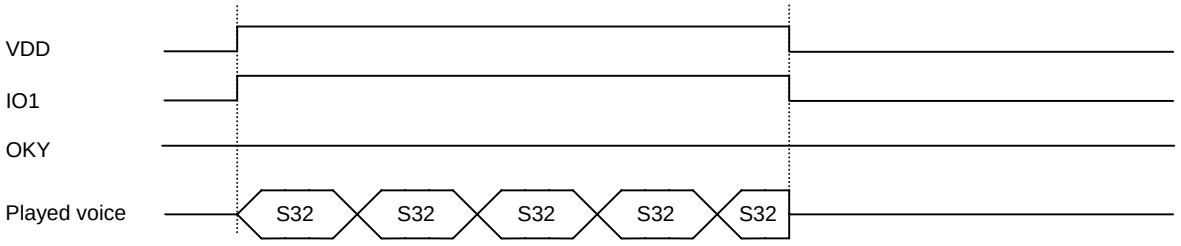


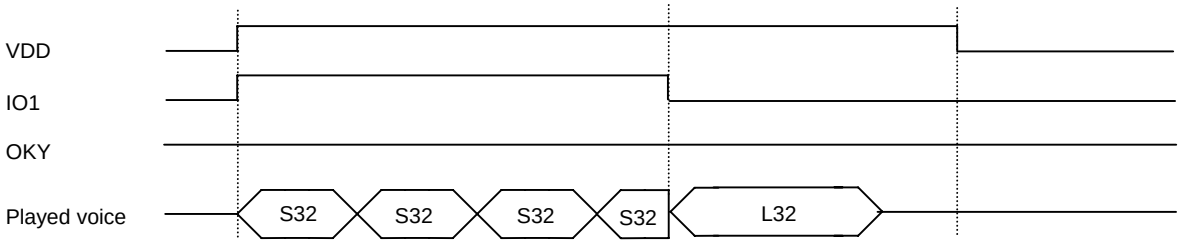
AlarmWithSnooze function is set,

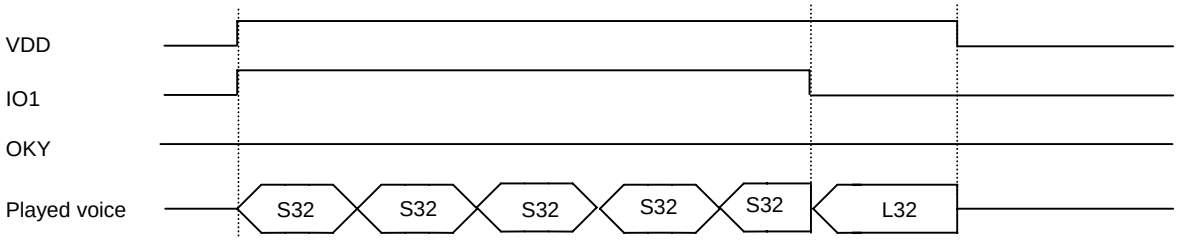
IO1 (L/x/R) =S32 L32, long debounce (The IO1's sub_table must be even number.)

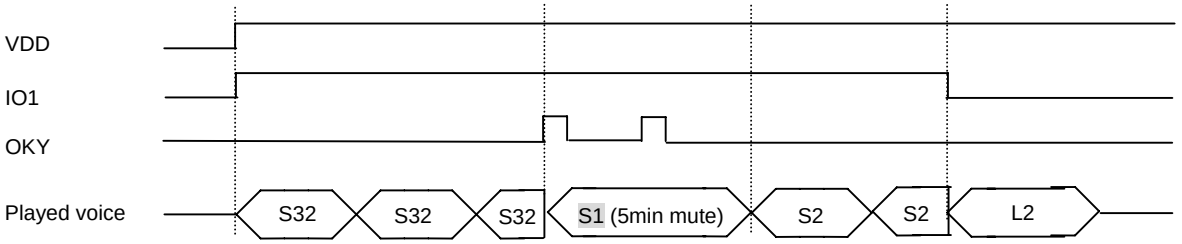
OKY (L/x/R) =S1 L1 S2 L2 S3 L3 S4 L4 S5 L5 ……. S30 L30 S31 L31, long debounce time

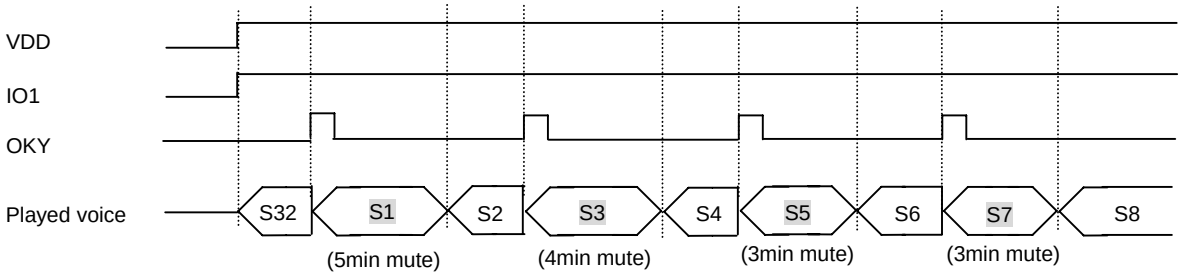
(All the Looping sub_tables are greeting voice. The even numbers of sub_table are Alarm voice. The odd numbers are Snooze voice of mute and here all steps must be inverted from the Retigger to Irretigger mode.)

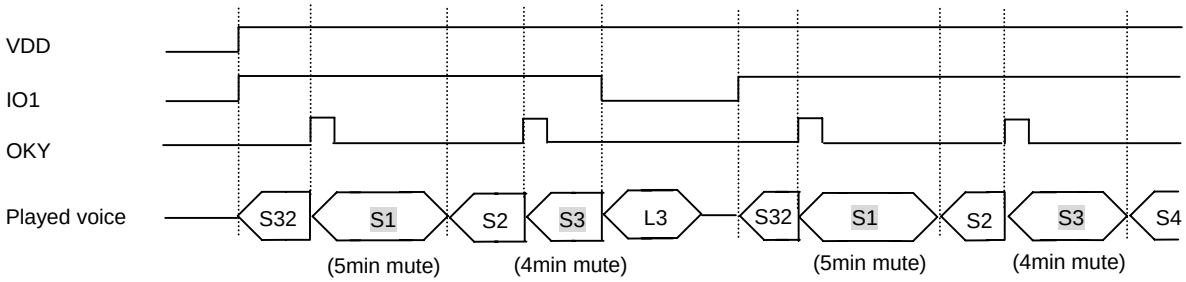


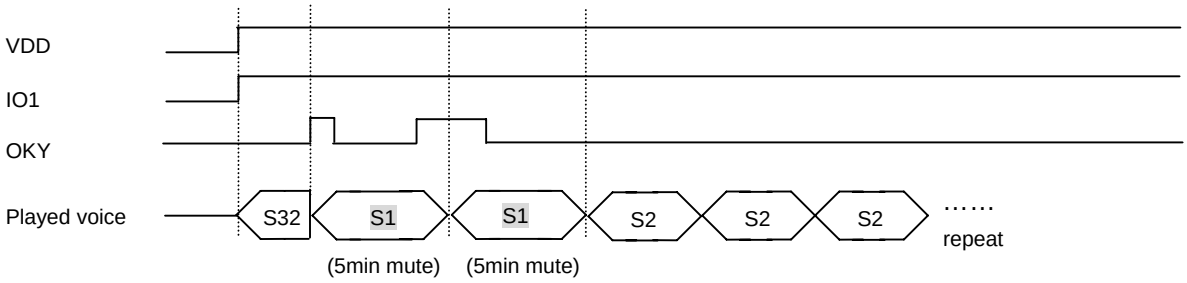


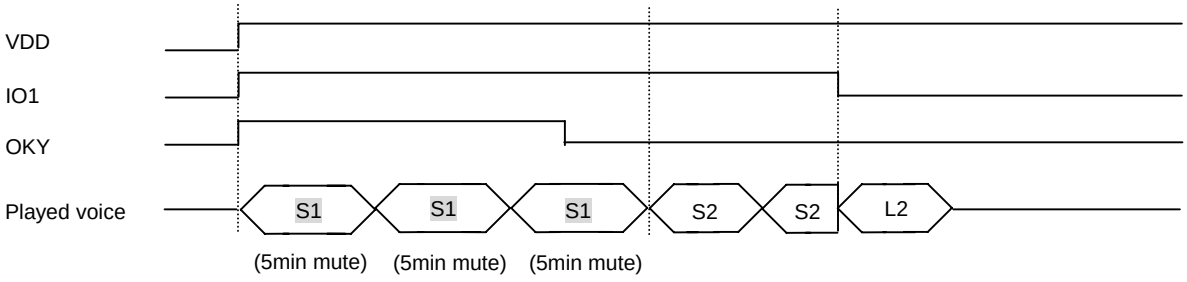


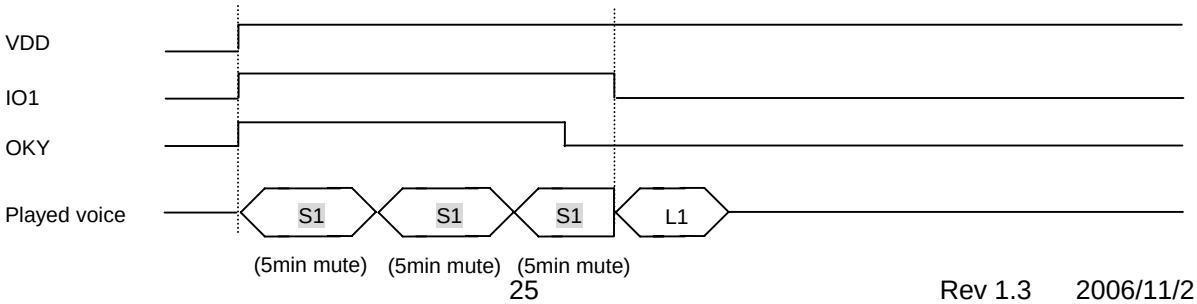

VDD
IO1
OKY
Played voice
S32
S32
S32
S1 (5min mute)
S2
S2
L2


VDD
IO1
OKY
Played voice
S32
S1
S2
S3
S4
S5
S6
S7
S8
(5min mute)
(4min mute)
(3min mute)
(3min mute)


VDD
IO1
OKY
Played voice
S32
S1
S2
S3
L3
S32
S1
S2
S3
S4
(5min mute)
(4min mute)
(5min mute)
(4min mute)

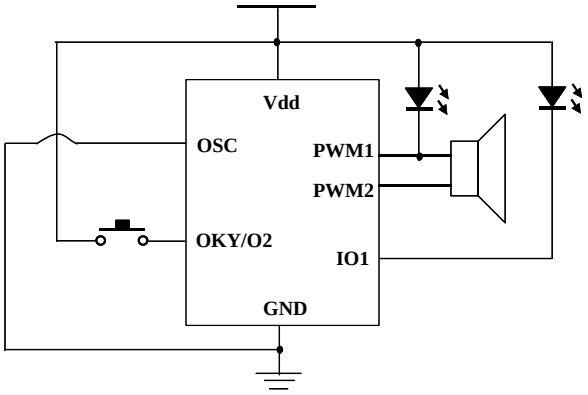

VDD
IO1
OKY
Played voice
S32
S1
S1
S2
S2
S2
……
repeat
(5min mute)
(5min mute)


VDD
IO1
OKY
Played voice
S1
S1
S1
S2
S2
L2
(5min mute)
(5min mute)
(5min mute)

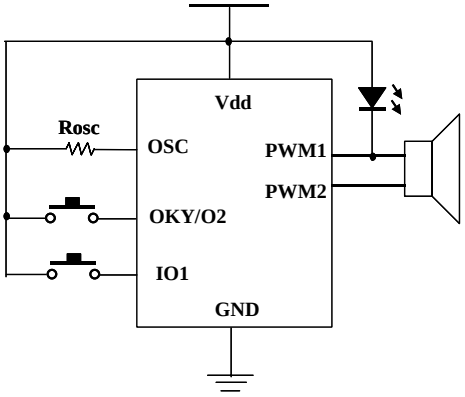

VDD
IO1
OKY
Played voice
S1
S1
S1
L1
(5min mute)
(5min mute)
(5min mute)

10. APPLICATION

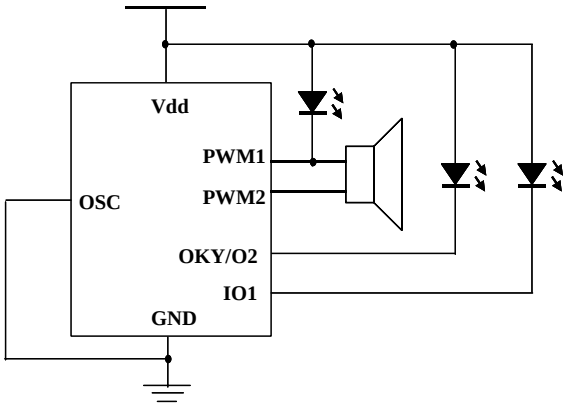
(1) 1 trigger, 2 LEDs, using internal oscillator
OKY is input, IO1 is output



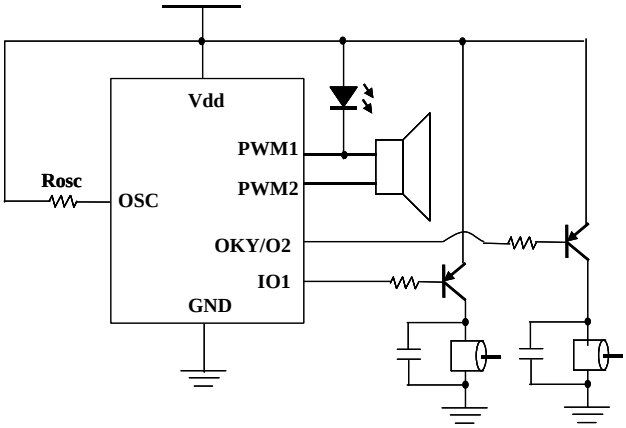
(2) 2 triggers, 1 LED, using external oscillator



(3) PowerOnPlay, 3 LEDs, internal oscillator
OKY and IO1 are output



(4) PowerOnPlay, 1 LED, 2 motors, external oscillator
OKY and IO1 are output



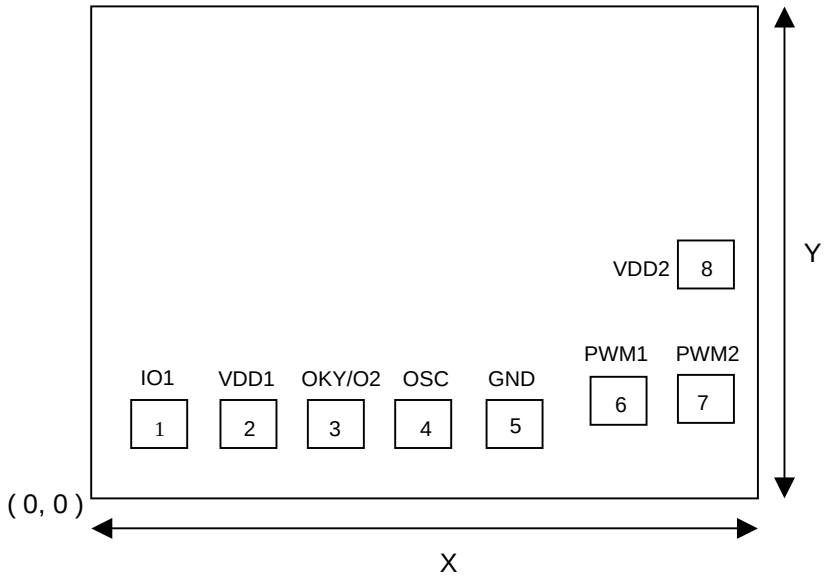
* Rosc=160KΩ (at 6kHz sample rate, SR option: J)

* OKY and IO1 are set to output mode, select "Busy_Low active" and "Sync output" for driving 2 motors.

* While driving motor, one capacitor is suggested to put between Vdd and GND.

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

11. BONDING DIAGRAM (For AM9AD Ver.A IC)



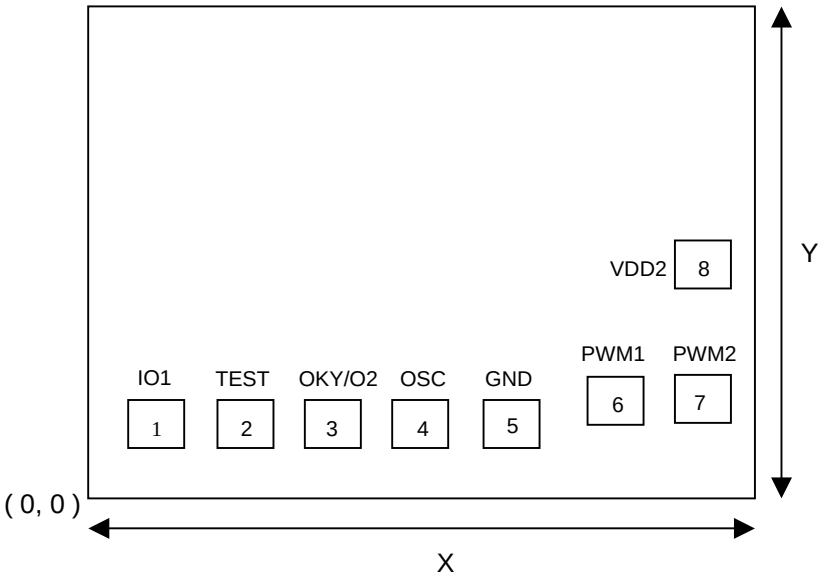
Pad size: 80 um x 80 um

※ The IC substrate must be connected to GND.

PAD LOCATION

Pad No.	Pad Name	X	Y
1	**IO1**	80	87
2	**VDD1**	189	87
3	**OKY/O2**	299	87
4	**OSC**	409	87
5	**GND**	519	87
6	**PWM1**	639	119
7	**PWM2**	749	119
9	**VDD2**	749	319

12. BONDING DIAGRAM (For AM9AD028D / AM9AD035D Ver.C IC)



Pad size: 80 um x 80 um

※ The IC substrate must be connected to GND.

PAD LOCATION

Pad No.	Pad Name	X	Y
1	**IO1**	80	87
2	**TEST**	189	87
3	**OKY/O2**	299	87
4	**OSC**	409	87
5	**GND**	519	87
6	**PWM1**	639	119
7	**PWM2**	749	119
9	**VDD2**	749	319