佑 華 微 電 子 股 份 有 限 公 司

AM9CAOTP

DATA SHEET

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Revision History

Rev	Date	Description	Page
1.30	2016/6/23	1) Update Chapter 8: Modify PWM current specification. 2) Update Chapter 10: Update 0.1uf capacitor as optional. 3) Add Chapter 13: Ordering Information.	17 25 30
1.20	2015/12/25	1) Add new IC body 9CA100x. 2) Add Section 8.1: Deviation Graph of Trim Frequency.	-
1.10	2014/10/23	1) Add new IC body AM9CE. 2) Modify Chapter 2: Modify I/O pin descriptions of AM9 series in Feature (4). 3) Modify Chapter 8: Change the data of F_{osc} lot variation. 4) Modify Chapter 10: Modify the note description for AM9CA065A(A).	
1.03	2014/8/25	Modify Chapter 4: Modify IO1 pin assignment of 14-Pin DIP & SOP.	-
1.02	2014/8/20	1) Modify Chapter 8: Add data of lsb and lop in the condition of VCC = 4.5 V. 2) Modify Chapter10: Add indications of 0.1uF capacitor on application circuits.	-
1.01	2014/7/31	Fix typos in the table of Features (2).	-
1.00	2014/7/29	New Release.	-

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1. 一般規格

AM9CAOTP 系列爲單晶片 CMOS 語音合成 OTP IC (One Time Programmable IC)，可支援 AM9AG、AM9AH、AM9AK、AM9AX、AM9BF、AM9BK、AM9CE 等 AM9 系列產品，具有 1 個 input 腳(OKY)、4 個 I/O 腳及一組 PWM 輸出。AM9CAOTP 系列除與支援的 AM9 系列有相同功能外，內部亦配有高精準度振盪器、LVR (Low Voltage Reset)及高下拉電流輸出(僅支援 AM9AK / AM9BK)。使用者可依據需求使用佑華所提供的 *EzSpeech* 系列軟體進行開發。

2. 特性

(1) 單一工作電壓範圍爲2.2 ~ 5.5伏特。

(2) AM9CAOTP可合成的語音長度，及對應可支援的AM9系列IC Body詳列如下：

<table>
<tr><th rowspan="2">語音長度 (秒)</th><th colspan="5">AM9CAOTP 與支援的 AM9 系列 IC Body</th></tr>
<tr><th>AM9CA014x</th><th>AM9CA035x</th><th>AM9CA065x</th><th>AM9CA100x</th><th>AM9CA130x</th></tr>
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<tr><td>100.61</td><td>-</td><td>-</td><td>-</td><td colspan="2">AM9CE100x</td></tr>
<tr><td>130.65</td><td colspan="2">-</td><td>-</td><td></td><td>AM9CE130x</td></tr>
</table>

(3) AM9CAOTP所支援的AM9系列之基本特性比較如下，詳細的功能說明請參閱各系列的Datasheet：

產品 / 特性	AM9AG	AM9AH	AM9AK	AM9AX	AM9BF	AM9BK	AM9CE
工作電壓範圍	2.2 ~ 5.5 V						
語音總長度[1] (秒)	3.24, 7, 10, 14	3.24, 7	3.24, 7	3.24, 6, 7	3.5, 7,10,14, 21, 28, 35, 42, 54, 65	3.5, 7,10,14, 21, 28, 35, 42	14, 35, 65, 130
語音段 (Voice Section)	最多256個語音段						
語音格 (Voice Step)	256個語音格						
語音組 (Subtable)	8	8	1	1	32	32	64
播放頻率[2]	5 ~ 14.5 KHz	5 ~ 14.5 KHz	5 ~ 14.5 KHz	5 ~ 14.5 KHz	4.4 ~ 15 KHz	4.4 ~ 15 KHz	4.4 ~ 15 KHz
輸出腳	IO1	-	O1	IO1	IO1, IO2	IO2	IO1, IO2, IO3, IO4
輸入腳	IO1, OKY	OKY	-	IO1	IO1, IO2, OKY	IO2, OKY	IO1, IO2, IO3, IO4, OKY
輸入優先順序	OKY > IO1	-	-	-	OKY > IO1 > IO2 > PowerOnPlay	OKY > IO2 > PowerOnPlay	OKY > IO1 > IO2 > IO3 > IO4 (OKY2) > PowerOnPlay
下拉電阻模式[3]	- CDS + 1M - CDS - 1M pull-low - Floating	- CDS + 1M - CDS - 1M pull-low - Floating	-	- CDS + 1M - CDS - 1M pull-low - Floating	- 40K pull-low - CDS + 1M - 1M pull-low - Floating	- 40K pull-low - CDS + 1M - 1M pull-low - Floating	- 40K pull-low - CDS + 1M - CDS - 1M pull-low - Floating
輸入模式	- 兩鍵觸發模式 - 單鍵觸發模式 - 長響模式	- 單鍵觸發模式	- 長響模式	- 單鍵觸發模式 - 長響模式	- PowerOnPlay - 兩鍵觸發模式 - 單鍵觸發模式 - 長響模式	- PowerOnPlay - 兩鍵觸發模式 - 單鍵觸發模式 - 長響模式	- PowerOnPlay - 兩鍵觸發模式 - 單鍵觸發模式
觸發方式[4] (透過光罩選擇)	- 邊緣 / 位準觸發 - 保持 / 非保持 - 可重新觸發 / 不可重新觸發	- 邊緣 / 位準觸發 - 保持 / 非保持 - 可重新觸發 / 不可重新觸發	-	- 邊緣 / 位準觸發 - 保持 / 非保持 - 可重新觸發 / 不可重新觸發	- 邊緣 / 位準觸發 - 保持 / 非保持 - 可重新觸發 / 不可重新觸發	- 邊緣 / 位準觸發 - 保持 / 非保持 - 可重新觸發 / 不可重新觸發	- 邊緣 / 位準觸發 - 保持 / 非保持 - 可重新觸發 / 不可重新觸發
輸出方式	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash	-	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash	- 3 Hz LED flash - 6 Hz LED flash - LED dynamic 2/4 - Power IO output	- 3 Hz LED flash - 6 Hz LED flash - LED dynamic 2/4 - Power IO output	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash - LED dynamic 2/4 - Power IO output
按鍵反應時間 (輸入腳)	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce	-	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce
Toggle On/Off 功能 (輸入腳)	無	無	無	無	有	有	有
音頻輸出	PWM1, PWM2						
語音段之語音或靜音長度	100 Hex 的倍數	-	100 Hex 的倍數	100 Hex 的倍數	40 Hex 的倍數	40 Hex 的倍數	40 Hex 的倍數
開發軟體工具	EzSpeech						

注意：

1. AM9CAOTP僅支援AM9系列的部分語音長度，見特性(2)表格。
2. AM9BF、AM9BK與AM9CE的播放頻率不爲OSC Trim頻率(4.4 KHz~15 KHz)時，無法保證頻率誤差在+/- 3%內。請參考 8.1節 的Trim頻率誤差分布圖。

3. 下拉電阻模式的「40K pull-low」選項僅限於AM9BF、AM9BK與AM9CE系列的OKY。

4. 若輸入模式爲「PowerOnPlay」，則觸發方式僅可選爲Edge / Hold / Retrigger。

(4) AM9CAOTP對應支援的AM9系列之I/O腳配置如下：

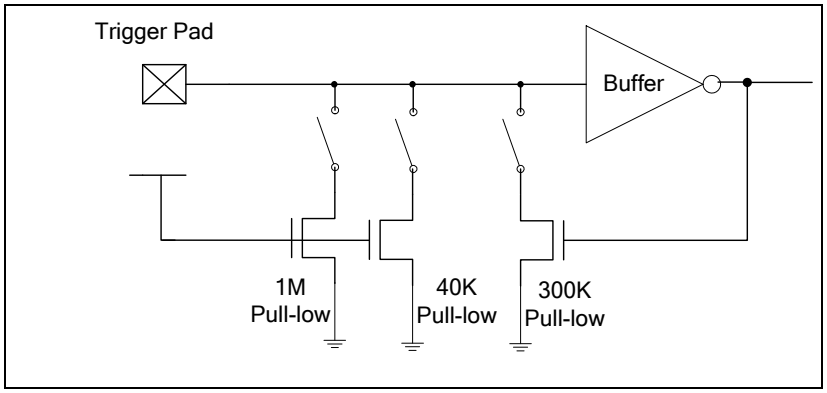
	AM9CAOTP				
	OKY	**IO1**	**IO2**	**IO3**	**IO4**
AM9AG	OKY	-	-	IO1	-
AM9AH	OKY	-	-	-	-
AM9AK	-	-	-	-	O1
AM9AX	-	-	-	IO1	-
AM9BF	OKY	-	-	IO1	IO2
AM9BK	OKY	-	-	-	IO2
AM9CE	OKY	IO1	IO2	IO3	IO4

"-" 表示AM9系列無此腳位。

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

(6) 輸入下拉電阻選項說明如下：

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。
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。



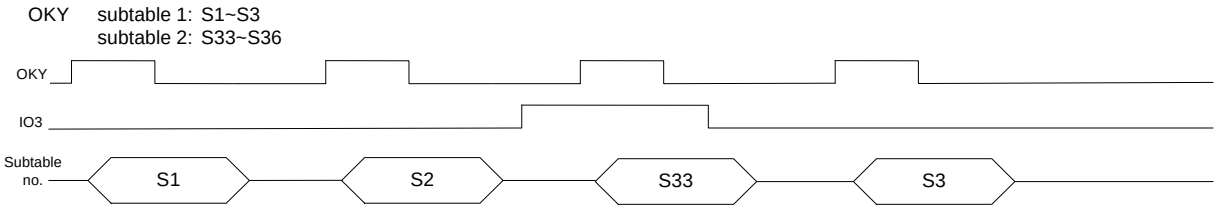
注意：OKY (AM9AG / AM9AH應用)及IO1、IO2、IO3、IO4當輸入時，沒有「40K pull-low」的選項。

(7) **Try_Me_Mode**

開啓Try_Me_Mode功能時，IO3預設爲輸入腳(Edge / Unhold / Retrigger)，且OKY可以設定兩組語音組(S1 ~ S32 及 S33 ~ S64)。以IO3爲選擇訊號，其時序圖的範例說明如下：

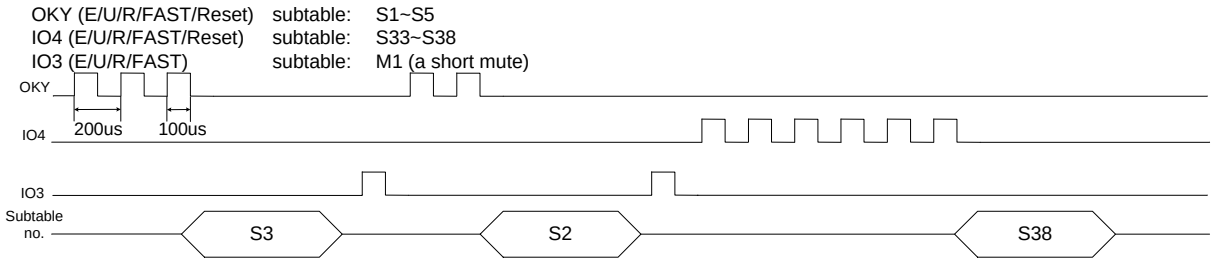
IO3低電位時：觸發OKY所播放的語音組爲第一組(S1 ~ S32)。

IO3高電位時：觸發OKY所播放的語音組爲第二組(S33 ~ S64)。



(8) **Serial Trigger**

開啓Serial Trigger功能時，IO3預設爲輸入腳(Edge / Unhold / Retrigger)、Short Debounce (並指定一個最短時間的靜音)；OKY、IO4預設爲Edge / Unhold / Retrigger、One-Key Sequential、Reset、Short Debounce。利用外部序列訊號輸入可直接指定OKY或IO4任一語音組播放，毋須依序播放語音組。此外，OKY或IO4的觸發時脈建議一個週期爲200 us (S.R. 6 KHz)。此應用通常會配合MCU使用。

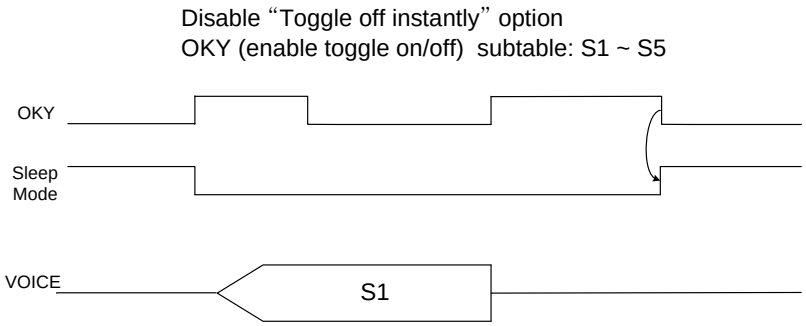


(9) **Toggle OFF instantly**

若開啓“Toggle OFF instantly”選項，當第二次按下按鍵時，IC會於按鍵訊號的正緣立即進入睡眠模式。若沒有開啓“Toggle OFF instantly”選項，第二次按下按鍵時，IC雖然會馬上停止PWM輸出但會在按鍵放開時才進入睡眠模式。

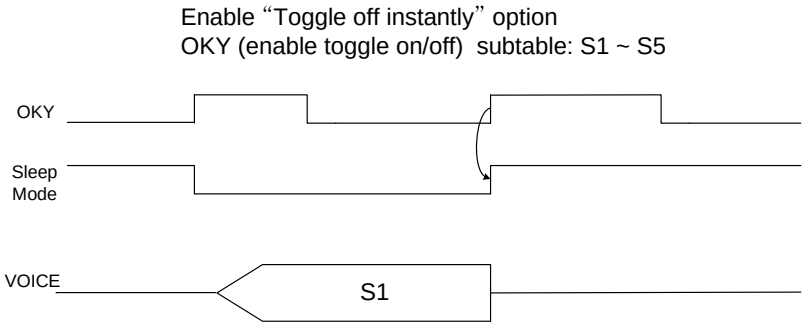
(a) 關閉“Toggle OFF instantly”選項：

放開第二次OKY時，IC才進入睡眠模式。



(b) 開啓“Toggle OFF instantly”選項：

按下第二次OKY時，IC立刻進入睡眠模式。



(10)**LVR (Low Voltage Reset)**：當電壓瞬間過低時，IC會自動重置(Reset)。

1. General Description

AM9CAOTP series is a single-chip voice synthesizing CMOS OTP IC (One Time Programmable IC) with one input pin (OKY), four I/O pins and one set of PWM output. It is designed for specific AM9 series products, such as AM9AG, AM9AH, AM9AK, AM9AX, AM9BF, AM9BK and AM9CE. In addition to equip with the same features as the supported AM9 series, AM9CAOTP series further comes with a built-in oscillator with high accuracy, LVR (Low Voltage Reset) and high current output from pull-low resistor (only for AM9AK / AM9BK). To facilitate the development process, convenient software *EzSpeech* is ready for use as needed.

2. Features

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

(2) The voice duration that can be synchronized using AM9CAOTP, and the supported AM9 series counterparts are all listed below:

<table>
<tr><th rowspan="2">語音長度 (秒)</th><th colspan="5">AM9CAOTP 與支援的 AM9 系列 IC Body</th></tr>
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<tr><td>35.07</td><td>-</td><td colspan="4">AM9BF021x, AM9BF028x, AM9BF035x, AM9BK021x, AM9BK028x, AM9BK035x, AM9CE035x</td></tr>
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<tr><td>100.61</td><td>-</td><td>-</td><td>-</td><td colspan="2">AM9CE100x</td></tr>
<tr><td>130.65</td><td colspan="2">-</td><td>-</td><td></td><td>AM9CE130x</td></tr>
</table>

(3) Here is a feature list of the supported AM9 series. For further details of each series, please refer to its dedicated Datasheet.

Product / Feature	AM9AG	AM9AH	AM9AK	AM9AX	AM9BF	AM9BK	AM9CE
Power Supply	2.2 ~ 5.5 V						
Voice Duration (Second)[1]	3.24, 7, 10, 14	3.24, 7	3.24, 7	3.24, 6, 7	3.5, 7,10,14, 21, 28, 35, 42, 54, 65	3.5, 7,10,14, 21, 28, 35, 42	14, 35, 65, 130
Voice Sections	up to 256						
Voice Steps	256						
Subtables	8	8	1	1	32	32	64
Playback Frequency[2]	5 ~ 14.5 KHz	5 ~ 14.5 KHz	5 ~ 14.5 KHz	5 ~ 14.5 KHz	4.4 ~ 15 KHz	4.4 ~ 15 KHz	4.4 ~ 15 KHz
Output Pin	IO1	-	O1	IO1	IO1, IO2	IO2	IO1, IO2, IO3, IO4
Input Pin	IO1, OKY	OKY	-	IO1	IO1, IO2, OKY	IO2, OKY	IO1, IO2, IO3, IO4, OKY
Input Priority	OKY > IO1	-	-	-	OKY > IO1 > IO2 > PowerOnPlay	OKY > IO2 > PowerOnPlay	OKY > IO1 > IO2 > IO3 > IO4 (OKY2) > PowerOnPlay
Pull-Low Resistor[3]	- CDS + 1M - CDS - 1M pull-low - Floating	- CDS + 1M - CDS - 1M pull-low - Floating	-	- CDS + 1M - CDS - 1M pull-low - Floating	- 40K pull-low - CDS + 1M - 1M pull-low - Floating	- 40K pull-low - CDS + 1M - 1M pull-low - Floating	- 40K pull-low - CDS + 1M - CDS - 1M pull-low - Floating
Input Trigger Modes	-Two Triggers Input -One Trigger Input -Continuous Play	- One Trigger Input	- Continuous Play	- One Trigger Input - Continuous Play	-PowerOnPlay -Two Triggers Input -One Trigger Input -Continuous Play	-PowerOnPlay -Two Triggers Input -One Trigger Input -Continuous Play	- PowerOnPlay -Two Triggers Input -One Trigger Input
Triggered By (Mask Option)[4]	- Edge / Level - Hold / Unhold - Retrigger / Irretrigger	- Edge / Level - Hold / Unhold - Retrigger / Irretrigger	-	- Edge / Level - Hold / Unhold - Retrigger / Irretrigger	- Edge / Level - Hold / Unhold - Retrigger / Irretrigger	- Edge / Level - Hold / Unhold - Retrigger / Irretrigger	- Edge / Level - Hold / Unhold - Retrigger / Irretrigger
Output Options	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash	-	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash	- 3 Hz LED flash - 6 Hz LED flash - LED dynamic 2/4 - Power IO output	- 3 Hz LED flash - 6 Hz LED flash - LED dynamic 2/4 - Power IO output	- Busy_High active - Busy_Low active - 3 Hz LED flash - 6 Hz LED flash - 12 Hz LED flash - LED dynamic 2/4 - Power IO output
Debounce Time (Input pin)	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce	-	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce	- Long Debounce - Short Debounce
Input Toggle On/Off Function	No	No	No	No	Yes	Yes	Yes
Audio Output	PWM1, PWM2						
Length of Voice or Mute in Voice Section	multiples of 100 Hex	-	multiples of 100 Hex	multiples of 100 Hex	multiples of 40 Hex	multiples of 40 Hex	multiples of 40 Hex
Development Tool	EzSpeech						

Note:

1. AM9CAOTP only supports certain voice duration of AM9 series as indicated in the table of Feature (2).
2. For AM9BF, AM9BK and AM9CE series, if the playback frequency is not set as OSC Trim frequency (within 4.4 KHz ~ 15 KHz), the +/- 3% deviation is not guaranteed. Please refer to Section 8.1 for Deviation Graph of Trim Frequency.
3. The option of “40K pull-low” is only available for OKY of AM9BF, AM9BK and AM9CE series.

4. If the input trigger mode is PowerOnPlay, only Edge / Hold / Retrigger triggering modes are available.

(4) Here are AM9CAOTP I/O pins and their counterparts in the supported AM9 series:

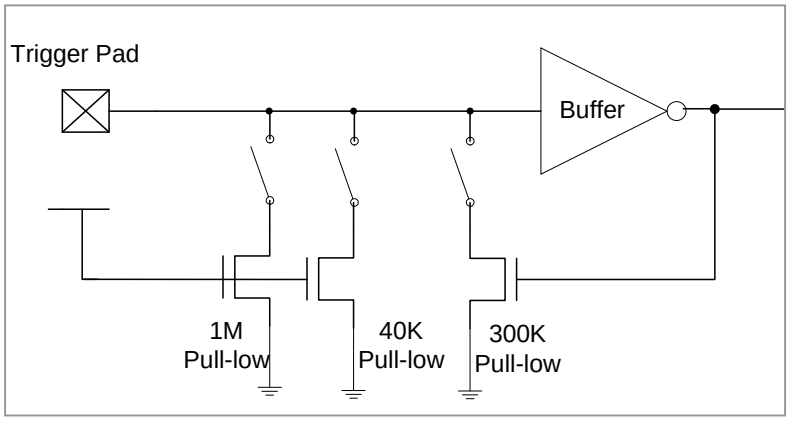
	AM9CAOTP				
	OKY	**IO1**	**IO2**	**IO3**	**IO4**
AM9AG	OKY	-	-	IO1	-
AM9AH	OKY	-	-	-	-
AM9AK	-	-	-	-	O1
AM9AX	-	-	-	IO1	-
AM9BF	OKY	-	-	IO1	IO2
AM9BK	OKY	-	-	-	IO2
AM9CE	OKY	IO1	IO2	IO3	IO4

"-" means this pin does not exist in AM9 series.

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

(6) Input Type Description:

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



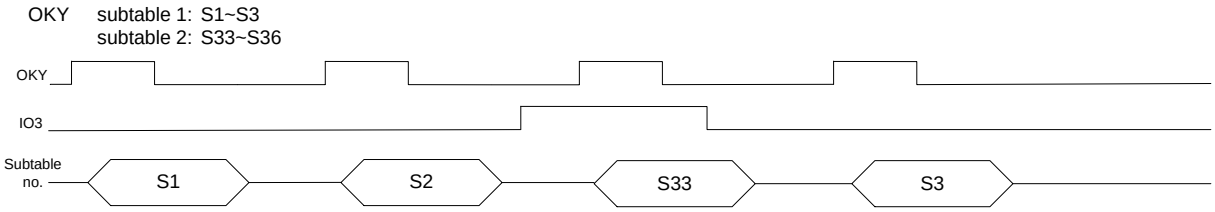
Note: The option of "40K pull-low" is not available for OKY (AM9AG / AM9AH), IO1, IO2, IO3 and IO4 input.

(7) **Try_Me_Mode**

When Try_Me_Mode is enabled, IO3 is defaulted as an input pin (Edge / Unhold / Retrigger), and OKY can be set with two subtables (S1 ~ S32 and S33 ~ S64). Here uses IO3 to select subtables, the timing diagram and description are as follows:

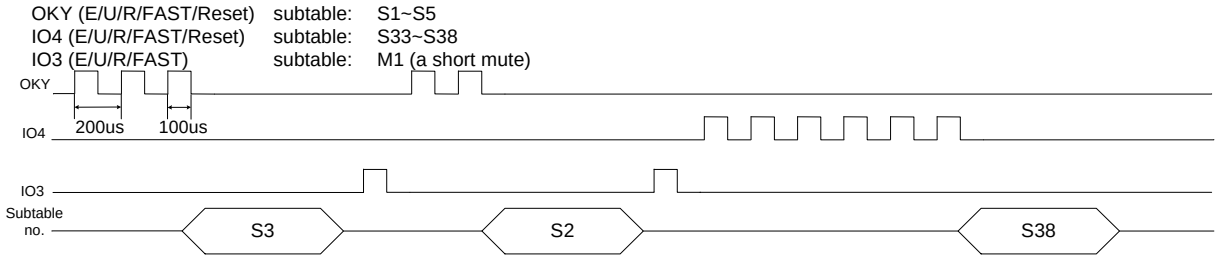
IO3 in low voltage: Trigger OKY to play the first subtable (S1 ~ S32) sequentially.

IO3 in high voltage: Trigger OKY to play the second subtable (S33 ~ S64) sequentially.



(8) **Serial Trigger**

When the Serial Trigger function is enabled, IO3 is defaulted as an input pin (Edge / Unhold / Retrigger) and set with Short Debounce (specified with a mute in a shortest time). Meanwhile, OKY and IO4 are defaulted as Edge / Unhold / Retrigger, One-Key Sequential, Reset Mode and Short Debounce. Using external serial signal inputs can directly specify any desired subtable of OKY / IO4 to play, without the need to play subtables sequentially. It is recommended to trigger OKY or IO4 by a 200 us clock signal (6 KHz S.R.). Applications using this function usually work together with an external MCU.



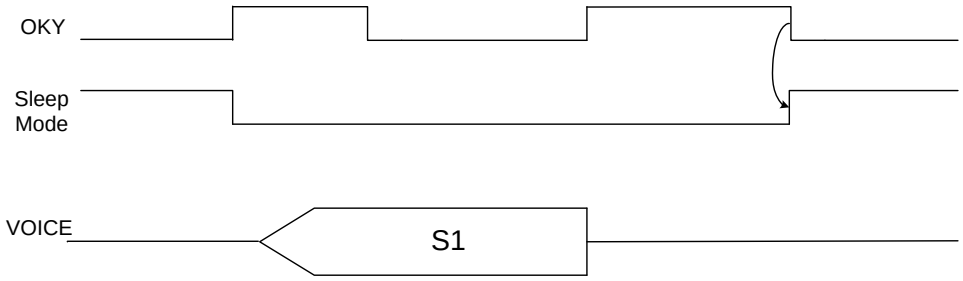
(9) **Toggle OFF instantly**

When the “Toggle OFF instantly” option is enabled, IC will enter Sleep Mode immediately at the positive edge of the second key-press signal. On the other hand, when the “Toggle OFF instantly” option is disabled, IC will stop PWM output immediately at the second key-press, yet IC will not enter Sleep Mode until the key is released.

(a) Disable the “Toggle OFF instantly” option:

IC enters Sleep Mode when the second OKY is released.

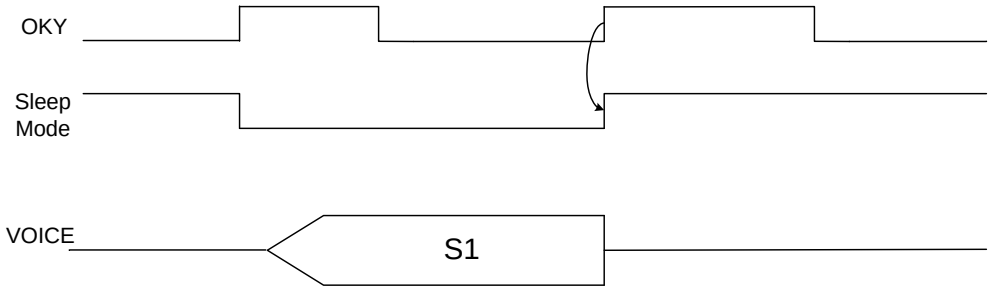
Disable “Toggle off instantly” option
OKY (enable toggle on/off) subtable: S1 ~ S5



(b) Enable the “Toggle OFF instantly” option:

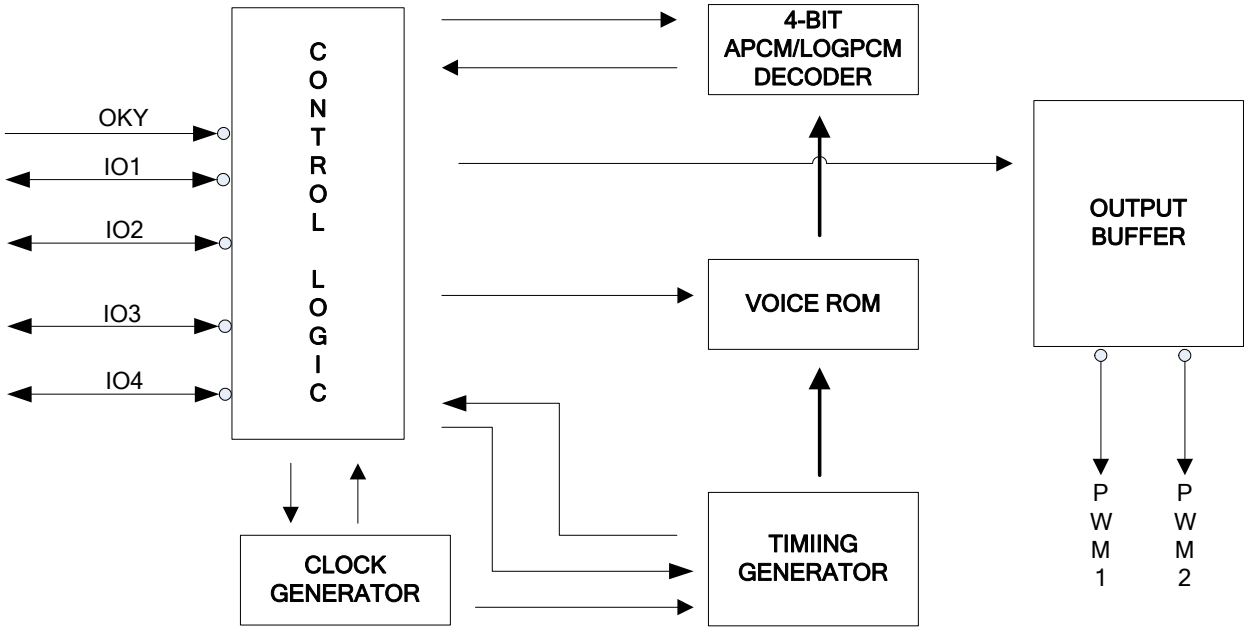
IC enters Sleep Mode immediately when the second OKY is pressed.

Enable “Toggle off instantly” option
OKY (enable toggle on/off) subtable: S1 ~ S5

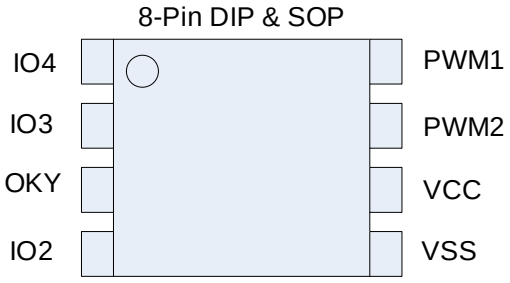


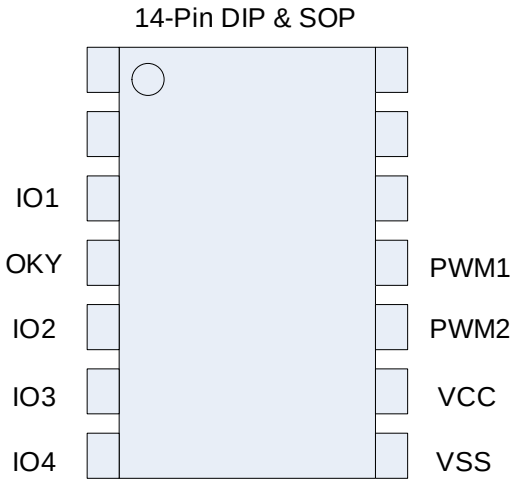
(10)**LVR (Low Voltage Reset):** IC will reset when its operation voltage drops too low.

3. Block Diagram



4. Pin Assignment of AM9CA014x / 035x / 065x / 100x / 130x





5. Pin Description

Pin Name	Pad No.	ATTR.	Function
OKY	1	I	Input for trigger.
IO1	2	I/O	Status output or input for trigger.
IO2	3	I/O	Status output or input for trigger.
IO3	4	I/O	Status output or input for trigger.
IO4	5	I/O	Status output or input for trigger.
VSS	6	Power	Negative power supply.
VCC	7	Power	Positive power supply.
PWM1	8	O	Audio output, floating when chip sleep.
PWM2	9	O	Audio output, floating when chip sleep.

6. Code Development & Demo System

User can use *EzSpeech* software tool to develop application functions. For details about using the software, please refer to *EzSpeech* User Manual. After code programming is complete, user will get files of .eva and .htm, one binary file and a function checklist. User can download the .eva file into AM9CA_DB demo board to demonstrate the programmed AM9CAOTP functions. The related mapping of AM9CA_DB is as follows:

	AM9CAOTP	AM9CA_DB	AM9CA_DB Description
I/O Pin	OKY	OKY	Input for trigger.
	IO1, IO2, IO3, IO4	IO1, IO2, IO3, IO4	Status output or input for trigger.
	PWM1, PWM2	PWM1, PWM2	PWM output to directly drive speaker.

For some input types, user may need to connect an external resistor. See the table below:

	AM9CAOTP	AM9CA_DB	AM9CA_DB Description
Input Type	CDS + 1M	CDS + 1M	Normal selection for key trigger. Only 1M pull-low resistor when key-pressed, and 1M+300K (parallel) pull-low resistor when key-released.
	CDS	CDS	Internal 300K ohms pull-low resistor, usually for photo-resistor trigger.
	40K pull-low	40K pull-low	Internal 40K ohms pull-low resistor, usually for large noise applications.
	1M pull-low	1M pull-low	Internal 1M ohms pull-low resistor, reserved for some special applications.
	Floating	Floating	No internal resistor connection, usually connected to other output pin or connected to VSS by an external resistor.

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

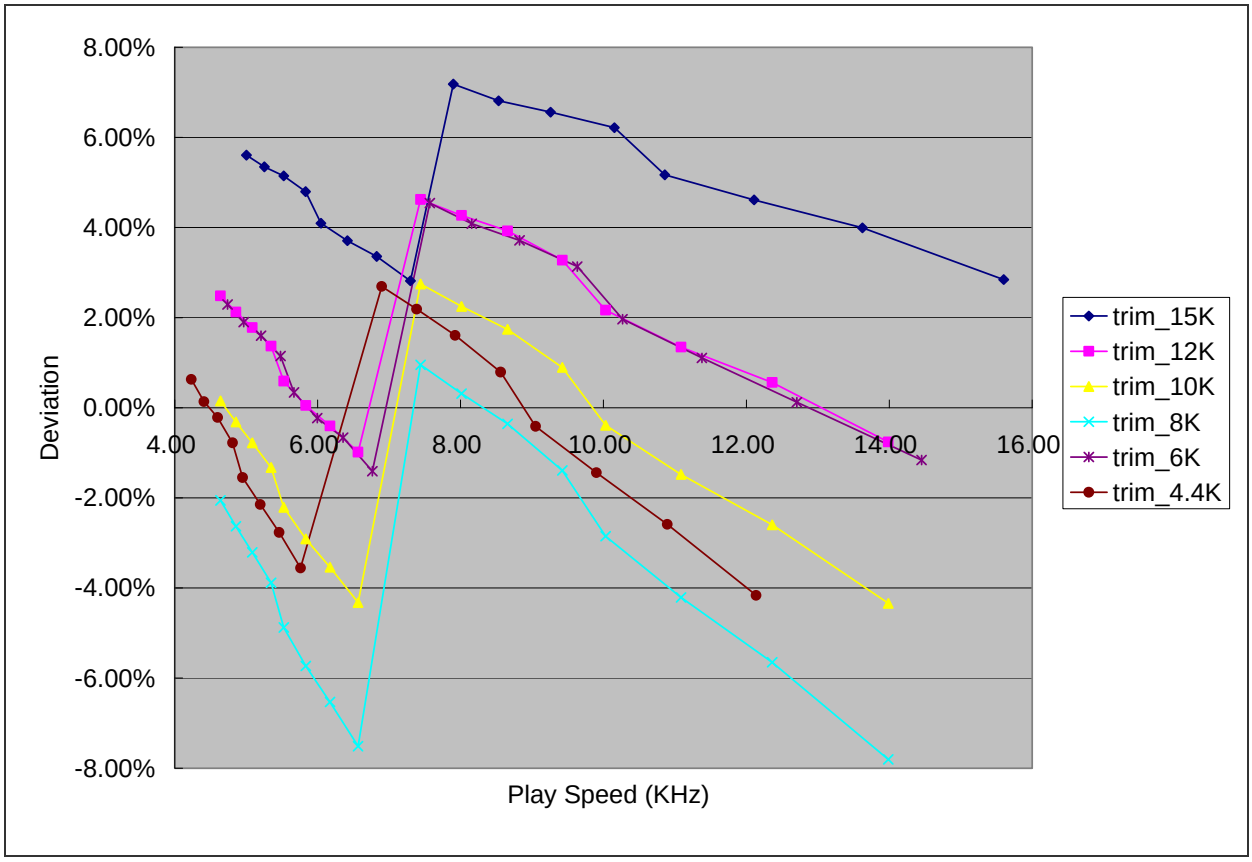
7. Absolute Maximum Rating

Symbol	Rating	Unit
V_{SS} ~ V_{CC}	-0.5 ~ +7.0	V
V_{in}	V_{SS}-0.3 < V_{in} < V_{CC}+0.3	V
V_{out}	V_{SS} < V_{out} < V_{CC}	V
T_{op} (operating)	0 ~ +70	ºC
T_{ST} (storage)	-25 ~ +85	ºC

8. DC Characteristics

Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
V_{CC}	Operating voltage		2.2	3.0	5.5	V	
F_{osc}	Operating Frequency		1126	1536	3840	KHz	Playback Speed: 4.4 KHz ~ 15 KHz
Isb	Supply current	Sleep			1	uA	V_{CC} = 3 V
					2		V_{CC} = 4.5 V
Iop		Operating		2.5		mA	V_{CC} = 3 V, 6 KHz S.R.
				3			V_{CC} = 4.5 V, 6 KHz S.R.
Iih	Input current (40K pull low)			100		uA	V_{CC} = 3 V
	Input current (1M pull low)			3		uA	V_{CC} = 3 V
	Input current (CDS)			10		uA	V_{CC} = 3 V
I_{PWM}	PWM output current		100			mA	V_{CC} = 3 V, Load = 8 ohm
Ioh	IO1, IO2, IO3, IO4 Output Current (Normal)			-1.6		mA	V_{CC} = 3 V, Vop = 2.6 V
				-4.5			V_{CC} = 4.5 V, Vop = 3.7 V
Iol				3.8			V_{CC} = 3 V, Vop = 0.4 V
				9.5			V_{CC} = 4.5 V, Vop = 0.8 V
Iol	IO1, IO2, IO3, IO4 Output Current (Large)			12		mA	V_{CC} = 3 V, Vop = 0.4 V
				28			V_{CC} = 4.5 V, Vop = 0.8 V
Iol	IO4 Output Current (High)			150		mA	V_{CC} = 3 V, Vop = 0.4 V
				300			V_{CC} = 4.5 V, Vop = 0.8 V
dF/F	Frequency Stability			3		%	$\frac{Fosc(3\ V)-Fosc(2.4\ V)}{Fosc(3\ V)}$
dF/F	Frequency Stability			3		%	$\frac{Fosc(4.5\ V)-Fosc(3\ V)}{Fosc(3\ V)}$
dF/F	Fosc lot variation		-3		3	%	V_{CC} = 3 V

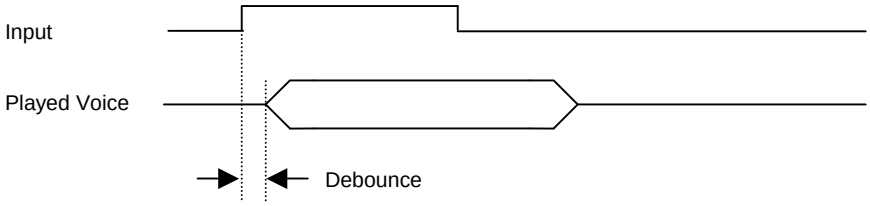
8.1 Deviation Graph of Trim Frequency



9. Timing Diagram

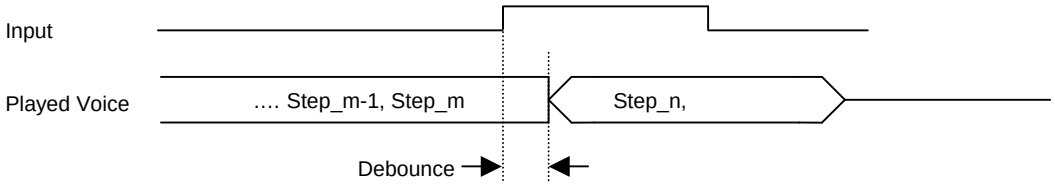
9.1 Debounce Time

1) Trigger while no voice is played



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

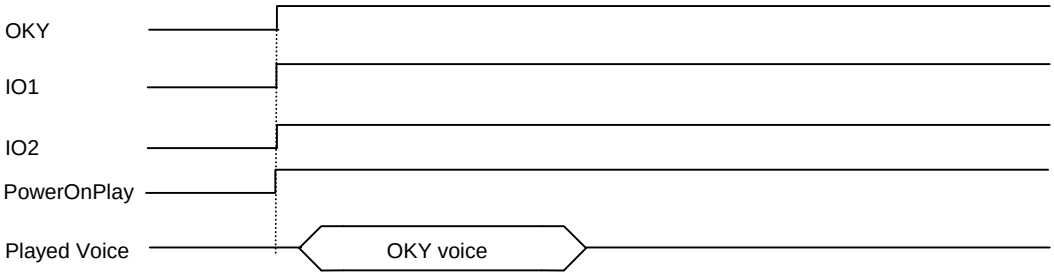
2) Trigger while voice is being played



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

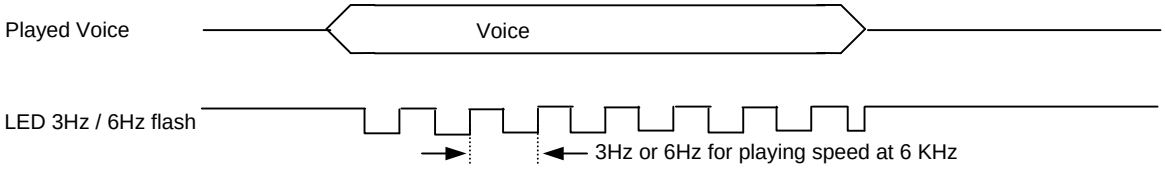
e.g.: if Step_m S.R.=8 KHz, Slow Debounce=20 * (6k / 8k) ms=15 ms while Fast Debounce < 50 * (6k / 8k) us=37.5 us.

9.2 Input Priority



※ OKY > IO1 > IO2 > PowerOnPlay

9.3 Status Output (IO1, IO2, IO3, IO4)

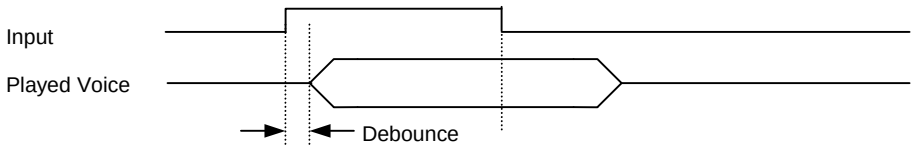


※ LED dynamic 2/4: When the voice amplitude is higher than 2/4 full-scale amplitude, LED will be ON, i.e. status output is low.

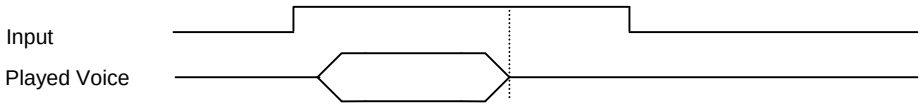
※ Power IO: Arbitrary output with voice, user can edit the Sync signal using PowerIO editor.

9.4 General Timing Diagram

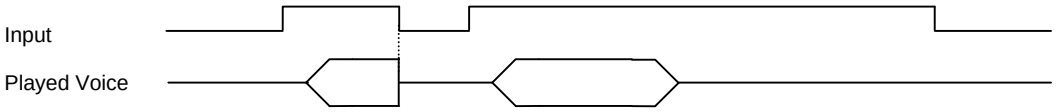
1) Edge Mode, Edge Trigger



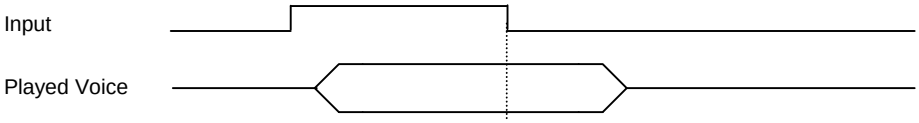
2) Edge Mode, Level Trigger



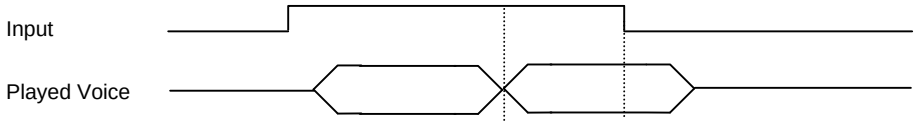
Edge/Hold



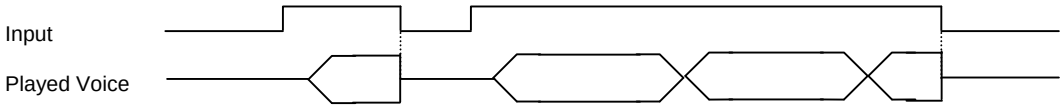
3) Level Mode, Edge Trigger



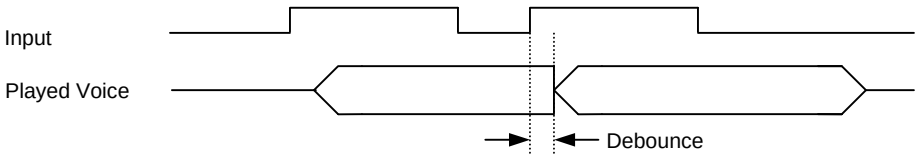
4) Level Mode, Level Trigger



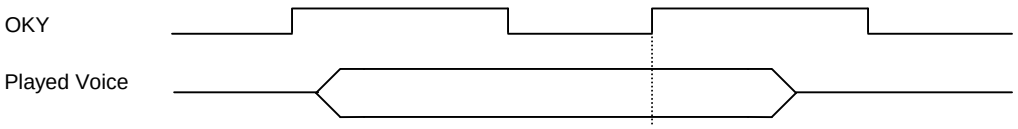
Level/Hold



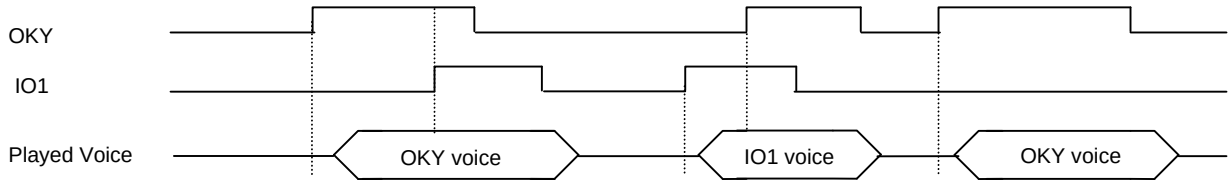
5) Retrigger Mode



6) Irretrigger Mode



7) Retrigger Mode, First Key Priority



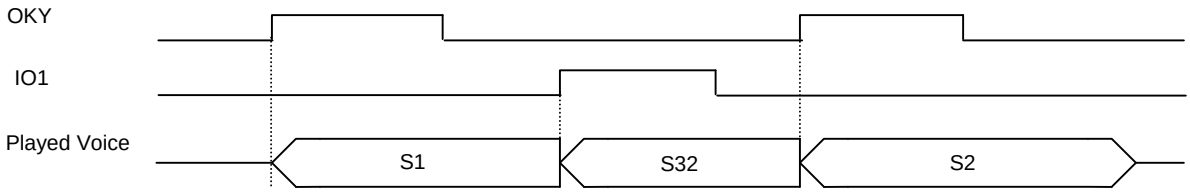
9.5 Special Timing Diagram

Debounce Time is ignored in the following diagrams.

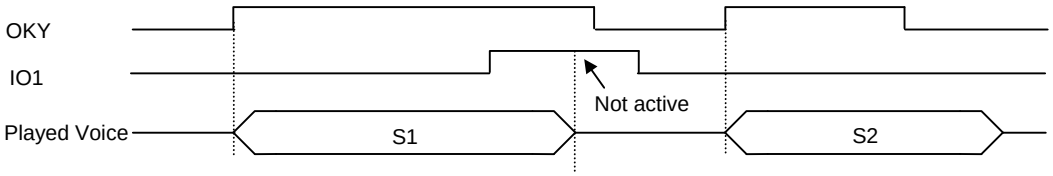
※ E, L, U, R and I indicated below respectively stands for the triggering modes of Edge, Level, Unhold, Retrigger and Irretrigger.

1) Different Input Reload

a) **OKY (E/U/R) = S1 S2 S3 S4, IO1 (E/U/R) = S32** (S1 stands for subtable1, and so on)

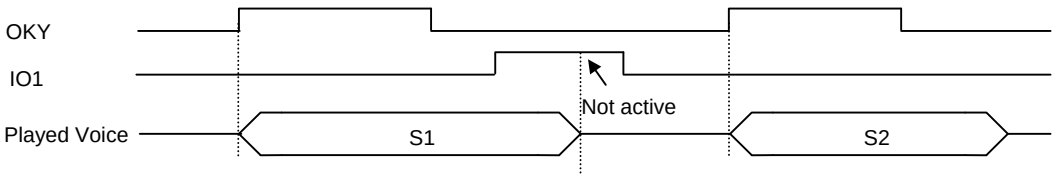


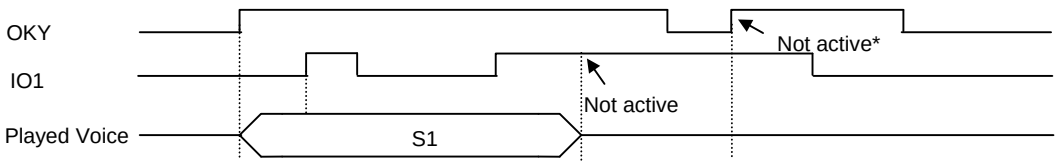
b) **OKY (E/U/R) = S1 S2 S3 S4, IO1 (L/x/x) = S32**



※ Reload key priority: OKY > IO1

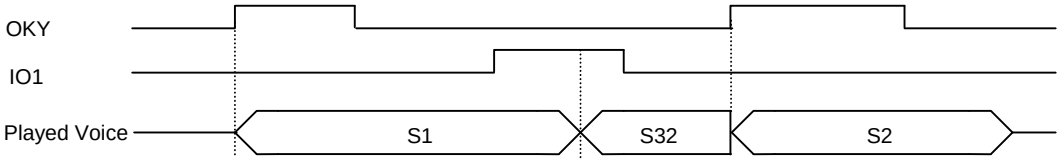
c) **OKY (E/U/I) = S1 S2 S3 S4, IO1 (E/x/x) = S32**



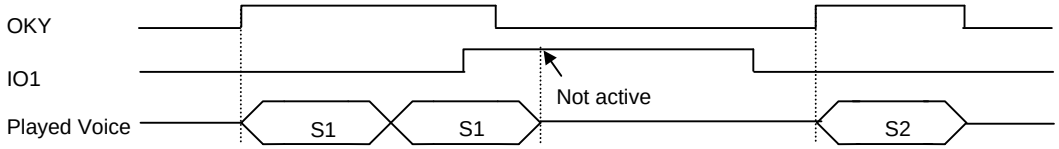


※ Because IO1 signal is still in high level, the OKY Edge signal is not active.

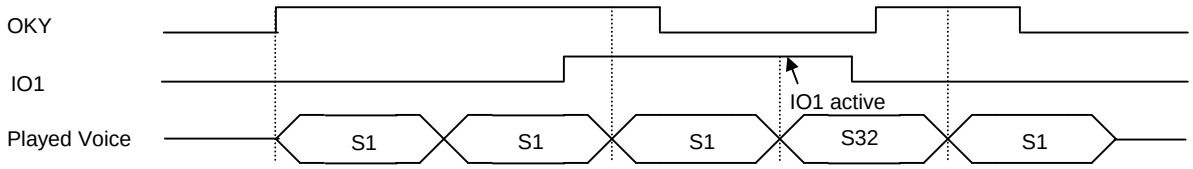
d) **OKY (E/U/I) = S1 S2 S3 S4, IO1 (L/U/R) = S32**



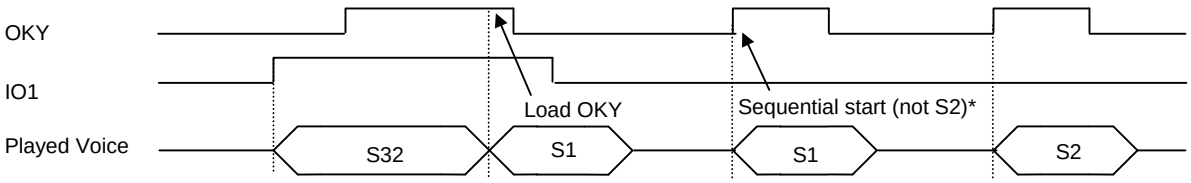
e) **OKY (L/U/x) = S1 S2 S3 S4, IO1 (E/x/x) = S32**



f) **OKY (L/U/x) = S1 S2 S3 S4, IO1 (L/U/x) = S32**



※ Reload key priority: OKY > IO1



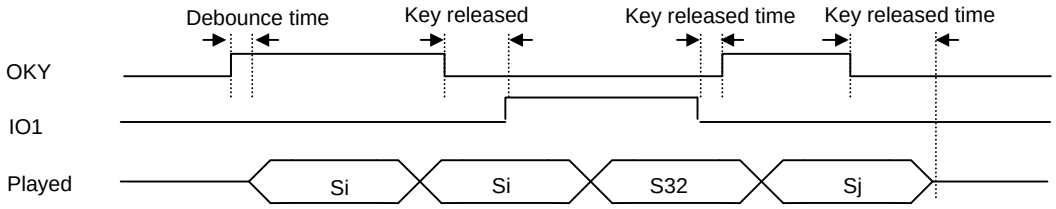
※ In OKY, 1st debounce occurs and then S1 starts playing. That is, OKY Sequential number is counted only when debounce occurs.

※ When IO1 has been triggered and starts its voice playing, triggering OKY won't be followed by a sequential trigger because no debounce occurs.

2) Random Function

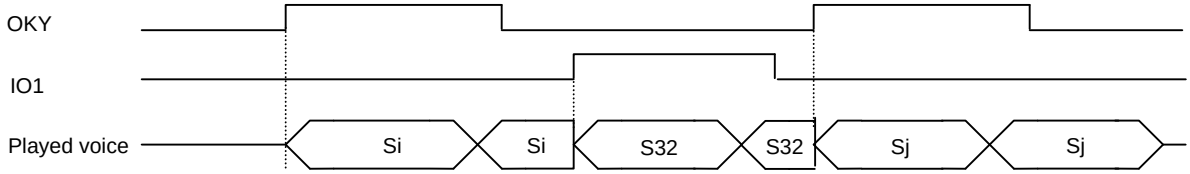
a) **OKY (L/U/I) = S1 S2 S3 S4, IO1 (L/U/I) = S32**

Random number is counted at Debounce Time and during voice playing when input key is released. The first trigger only counts Debounce Time because there is no key-released time.



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

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

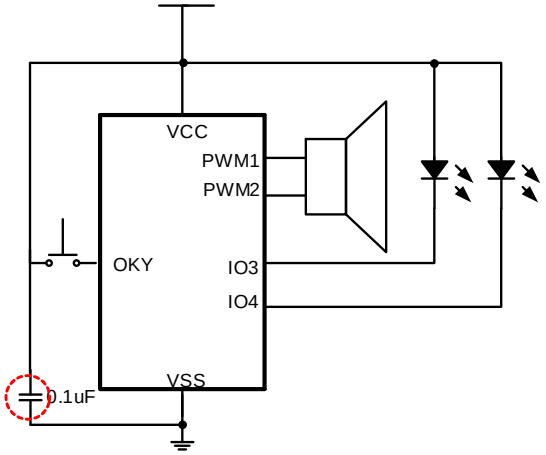


i=1 or 2 or 3 or 4; j=1 or 2 or 3 or 4 (i and j are random number)

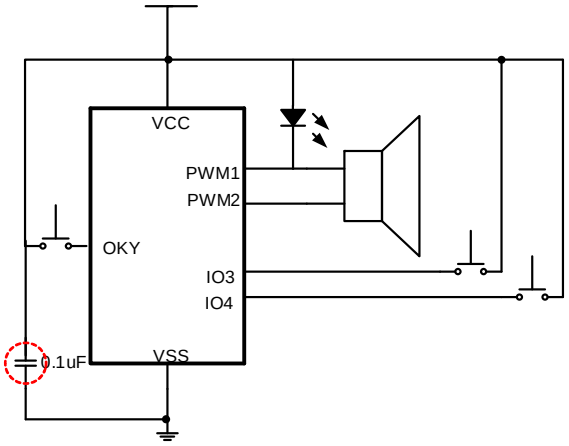
10. Application Circuit

(1) 1 trigger, 2 LEDs.

OKY is input while IO3 and IO4 are output.

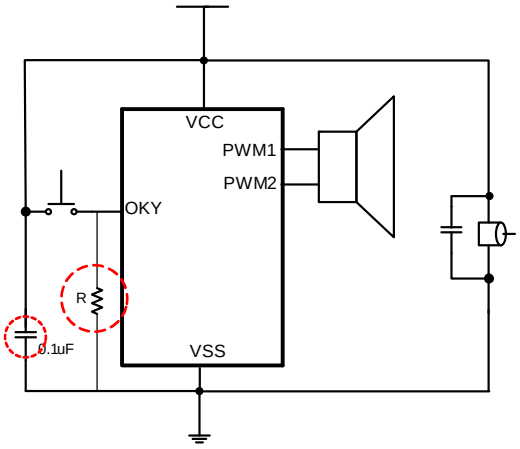


(2) 3 triggers, 1 LED.



(3) 1 triggers, 1 motor.

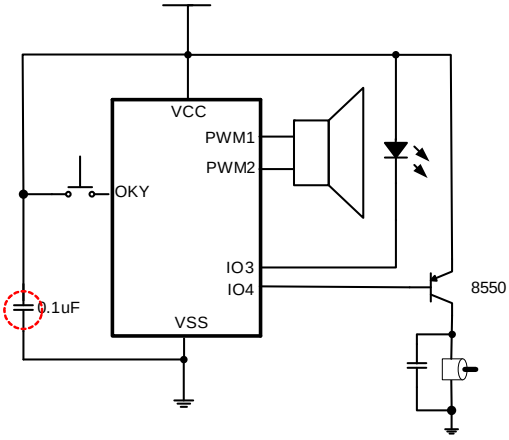
OKY is input.



* When driving the motor, it is recommended to place one capacitor between V_{CC} and V_{SS}.
* For AM9CA065A(A), if the capacitance of its power capacitor is higher than 0.1uF, it is recommended to place one resistor (1M ohm) between OKY and V_{SS}, as marked in the above dashed circle.

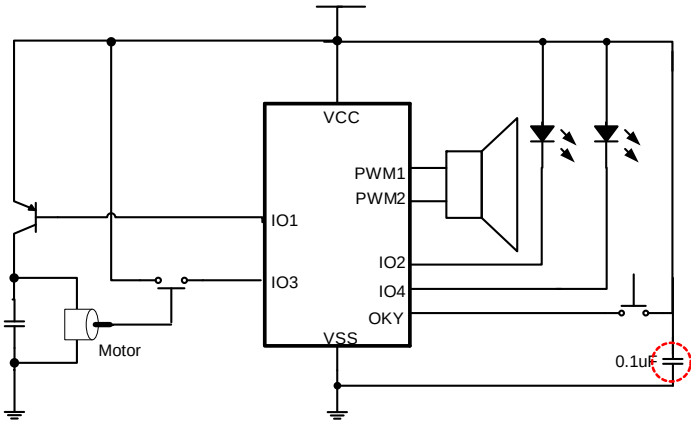
(4) 1 trigger, 1 LED, 1 motor.

IO3 and IO4 are output.

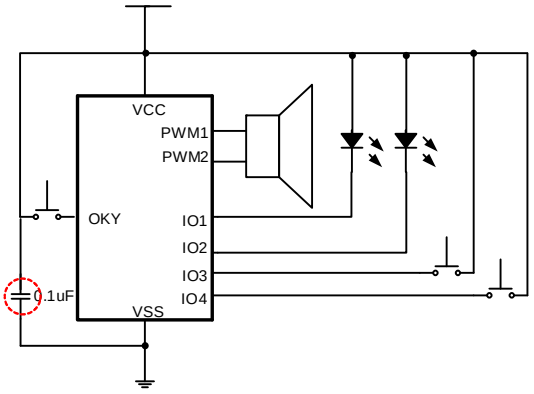


* Set IO3 and IO4 as output mode, and select “Sync output” for driving the motor.
* When driving the motor, it is recommended to place one capacitor between V_{CC} and V_{SS}.

(5) OKY is input, IO1 is output, IO3 is input.

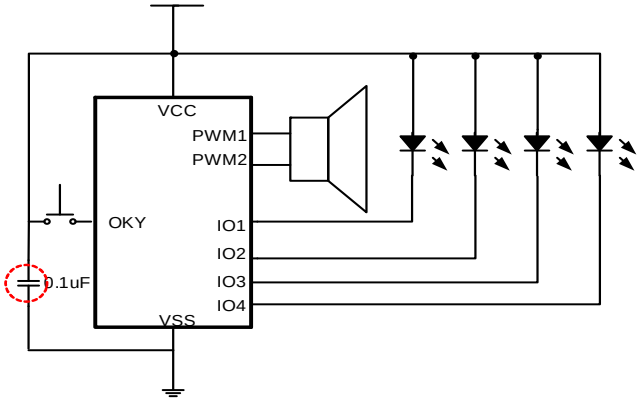


(6) 3 triggers, 2 LED, external oscillator.



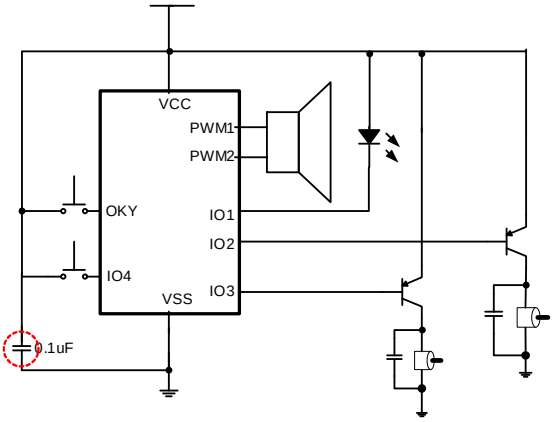
(7) 1 input, 4 LEDs, internal oscillator.

IO1 / IO2 / IO3 / IO4 are output.



(8) 2 triggers, 1 LED, 2 motors, external oscillator.

IO1 / IO2 / IO3 are output.



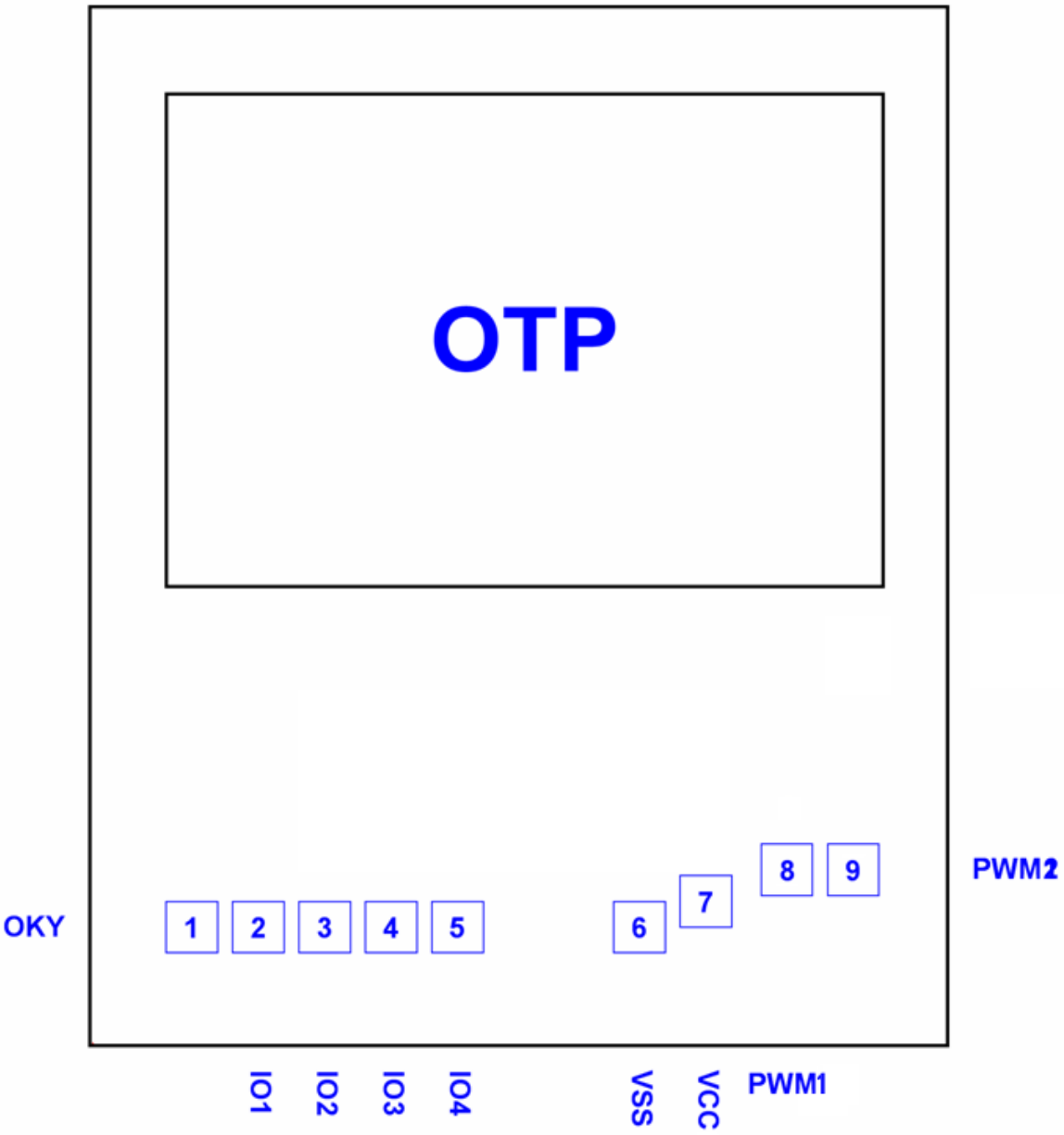
* Set IO1 / IO2 / IO3 as output mode, and select “Sync output” for driving 2 motors and 1 LED.

* When driving motors, it is recommended to place one capacitor between V_{CC} and V_{SS}.

Note:

1. The above application circuits are for reference only. For further information, please contact Alpha.
2. The 0.1uF capacitor is optional in AM9CA014x, AM9CA035x

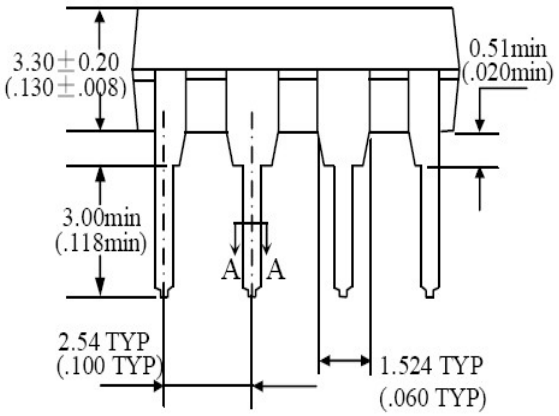
11. Pad Location

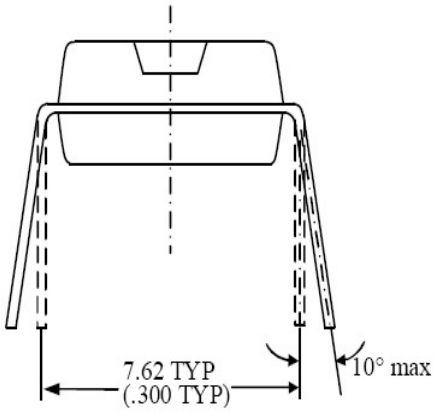


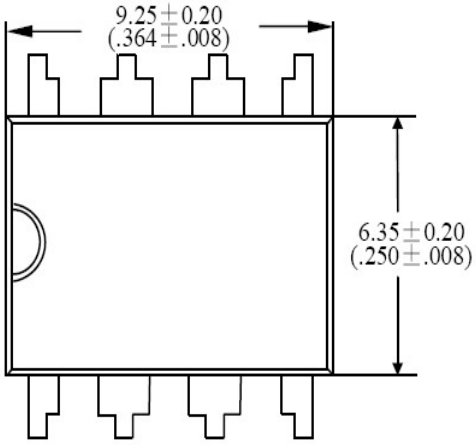
Note: The IC substrate must be connected to V_{SS}.

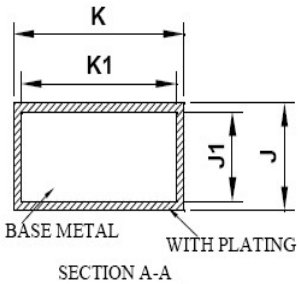
12. Package Dimension of AM9CA014x / 035x / 065x / 100x / 130x

8-Pin DIP 300 mil



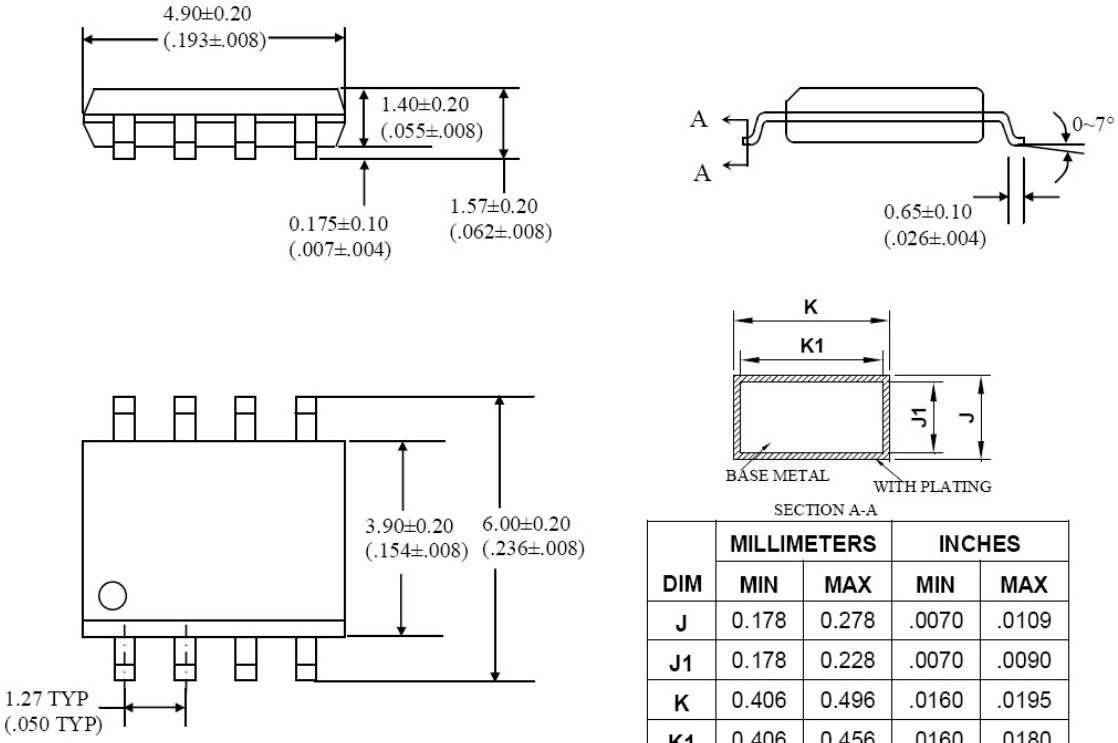






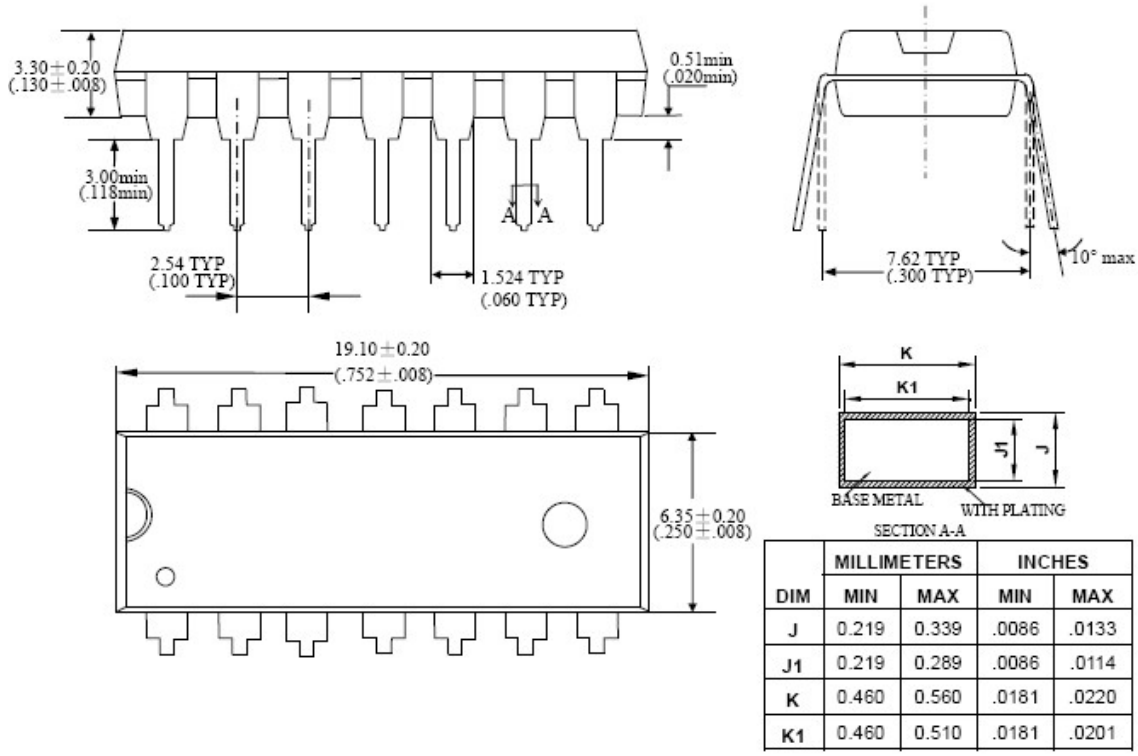
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
J	0.219	0.339	.0086	.0133
J1	0.219	0.289	.0086	.0114
K	0.460	0.560	.0181	.0220
K1	0.460	0.510	.0181	.0201

8-Pin SOP 150 mil



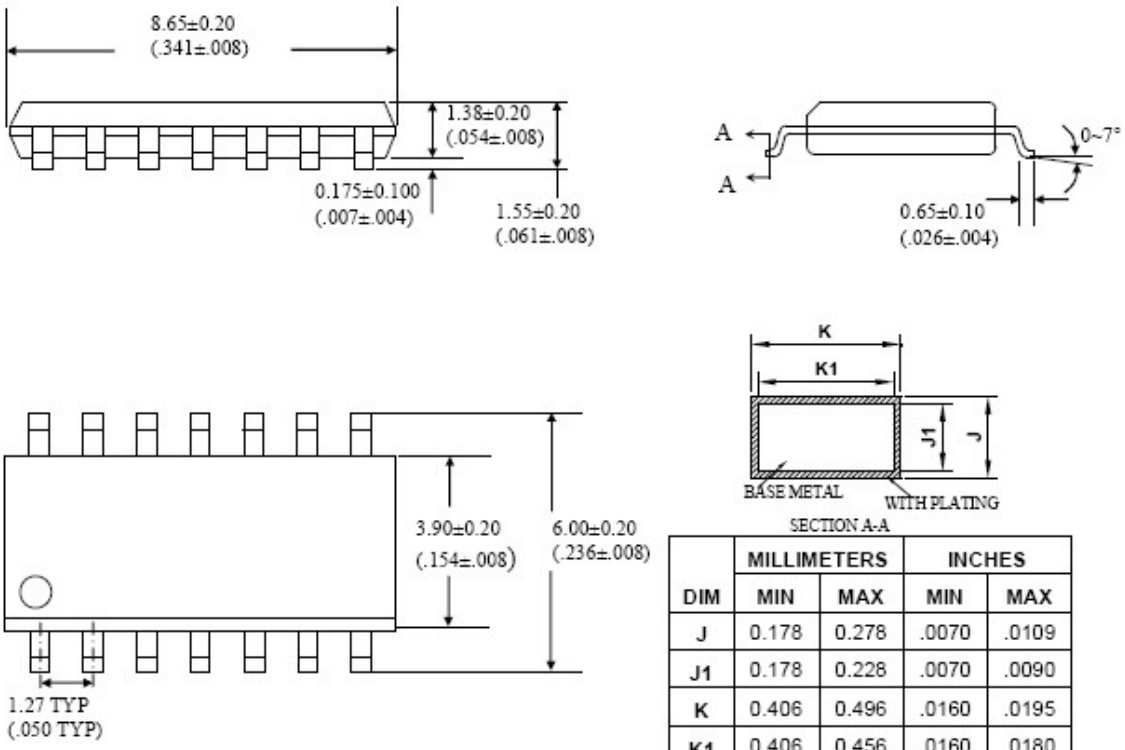
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
J	0.178	0.278	.0070	.0109
J1	0.178	0.228	.0070	.0090
K	0.406	0.496	.0160	.0195
K1	0.406	0.456	.0160	.0180

14-Pin DIP 300 mil



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
J	0.219	0.339	.0086	.0133
J1	0.219	0.289	.0086	.0114
K	0.460	0.560	.0181	.0220
K1	0.460	0.510	.0181	.0201

14-Pin SOP 150 mil



	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
J	0.178	0.278	.0070	.0109
J1	0.178	0.228	.0070	.0090
K	0.406	0.496	.0160	.0195
K1	0.406	0.456	.0160	.0180

13.Ordering Information

P/N *	Package Type	Pin Count	Package Size
AM9CA014BW	PDIP	8	300mil
AM9CA014BX	SOP	8	150mil
AM9CA014BP	PDIP	14	300mil
AM9CA014BS	SOP	14	150mil
AM9CA035BW	PDIP	8	300mil
AM9CA035BX	SOP	8	150mil
AM9CA035BP	PDIP	14	300mil
AM9CA035BS	SOP	14	150mil
AM9CA065BW	PDIP	8	300mil
AM9CA065BX	SOP	8	150mil
AM9CA065BP	PDIP	14	300mil
AM9CA065BS	SOP	14	150mil
AM9CA130BW	PDIP	8	300mil
AM9CA130BX	SOP	8	150mil
AM9CA130BP	PDIP	14	300mil
AM9CA130BS	SOP	14	150mil

AM9DA SERIES
DATA SHEET

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Revision History

Rev	Date	Description	Page
0.00	2017/5/17	Preliminary version.	-

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Table of Contents

1. 一般規格

AM9DA 系列爲單晶片 CMOS 語音合成 IC，是非常低成本且高實用性的語音 IC 產品。本系列使用 4bit, 4vbit, 5bit, 6bit DPCM 和 PCM 編碼方式，可合成長達 14、35、65、130 秒之語音。此外，本系列具有 5 個 I/O 腳(OKY、IO1~IO4)及一組 PWM 輸出，以配合不同需求彈性應用，內部亦配有高精準度振盪器、LVR (Low Voltage Reset)。使用者可依據需求使用佑華所提供的 *EzSpeech* 系列軟體進行開發。

2. 特性

(1) 單一工作電壓範圍爲 2.2 ~ 5.5 伏特。

(2) AM9DA 系列語音總長度可達 **14、35、65、130** 秒，且最多可被分割成 256 個語音段(Voice Section)，每段長度可不同。

Product	Voice Duration (sec)	I/O	Subtable	Step	Play Speed (Hz)	Factor	PIO Sync	PWM	LVR
AM9DA014x	14	1	16	256	共 25 種 4K~25K	1~12, PCM	—	Large	V
AM9DA035x	35	5	64				V	Normal /Large	
AM9DA065x	65	5	64				V		
AM9DA130x	130	5	64				V		

(3) 在 6 KHz 取樣頻率下，每一段語音的長度分別最多可達 **14、35、65、130** 秒；且每一段靜音時間的長度，最多可達 43 秒。

(4) 每一段語音可編入 5 組 Sync 信號(5 個 Sync 給 OKY、IO1、IO2、IO3 及 IO4 使用)，可使用 PowerIO 編輯器編輯 Sync 信號。

註：AM9DA014 不提供 Sync 訊號。

(5) 共有 256 個語音格(Voice Step)，根據不同秒數的母體，可規劃成 16 或 64 個語音組(Subtable)，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 OKY、IO1、IO2、IO3 及 IO4 的輸出致能或非致能(OKY、IO1、IO2、IO3 和 IO4 當作輸出時)。

註：AM9DA014 僅提供 1 組輸出訊號。

(6) 在語音組的最後一個語音格中可設定 "語音組循環" 功能(Loop)，可將現在的語音組(Start subtable, 例如 S1)重複播放；或是 "語音組跳躍" 功能(Jump)，可將現在的語音組(Start subtable, 例如 S1)播完後，接著播放指定的語音組(Jump subtable, 例如 L1)；更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(Jump and Loop)，詳細請參考 8.6 節。

(7) 特殊功能選項 "KeyReleaseJump" (按鍵離開立即跳躍)功能，可以配合 Jump 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 Loop 設定是否要將 L1 做無限循環的播放，詳細請參考 8.7 節。

(8) 內建振盪器，使用者可在 4 KHz ~ 25 KHz 中選擇任意播放速度。

注意：當選擇的播放頻率不爲 OSC Trim 頻率(4 KHz ~ 25 KHz)時，無法保證頻率誤差在+/- 3%內。

(9) OKY、IO1 、IO2、IO3 與 IO4 皆可選擇作輸入腳或輸出腳

註：AM9DA014 僅提供 OKY1 I/O 腳位。

(10)每一語音段中的語音與靜音長度爲 40HEX 的整數倍。

(11)特殊功能選項 “電源啓動” 功能(PowerOnPlay)，在上電時播放 ”上電語音組” (POP Subtable)，並可搭配 "語音組跳躍" 功能(Jumping)、"語音組循環" 功能(Looping)或 "語音組跳躍循環" 功能(Jumping and Looping)，詳細請參考 8.6.4 節。

注意：PowerOnPlay 觸發輸入模式只能選擇 Edge / Unhold / Retrigger 或 Edge / Unhold / Irretrigger。

(12)按鍵觸發輸入模式：

(a) 每一種輸入可選擇不同觸發方式：
邊緣觸發/位準觸發(Edge/Level)；保持/非保持(Hold/Unhold)；可重新觸發/不可重新觸發(Retrigger/Irretrigger)。

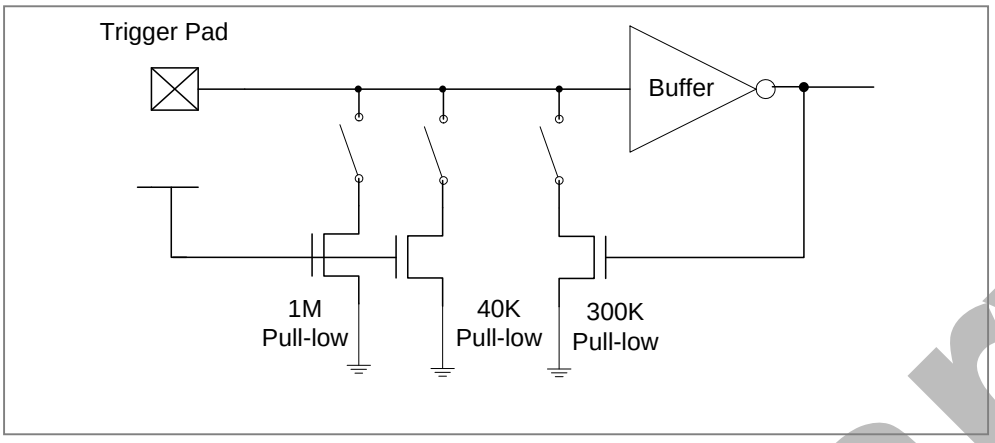
(b) OKY 輸入最多有 64 個 Subtable 的 One-Key Sequential 或 Random 的選擇，在 One-Key Sequential 時可選擇當其他按鍵被觸發後 Subtable 的順序是否要 Reset。

(c) OKY、IO1、IO2、IO3 或 IO4 (OKY2)其中之一的輸入可選擇是否有 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、IO3 及 IO4 (OKY2)輸入可選擇 CDS+1M、CDS、1M pull-low 或 floating 的輸入方式。

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。
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。



注意：IO1、IO2、IO3 及 IO4 爲輸入時，沒有 40K pull-low 的選項。

(e) 每一種輸入可選擇不同按鍵反應時間(Debounce Time)：

- 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 > IO3 > IO4 (OKY2) > PowerOnPlay。

(13)IO1、IO2、IO3 或 IO4 設定爲輸出腳時，有以下 7 種輸出方式可選擇：

(a) 3 Hz flash：當播放速度爲 6 KHz 時，播放時會輸出 3 Hz 閃爍。

(b) 6 Hz flash：當播放速度爲 6 KHz 時，播放時會輸出 6 Hz 閃爍。

(c) 12 Hz flash：當播放速度爲 6 KHz 時，播放時會輸出 12 Hz 閃爍。

(d) Busy_High active：播放時輸出高準位。

(e) Busy_Low active：播放時輸出低準位。

(f) Dynamic 2/4：播放時輸出動態 2/4 位準訊號。

(g) Power IO 輸出：可隨聲音作任意的輸出變化(須開啓 PowerIO 編輯器編輯 Sync 訊號)。

(14)一組 10 bit PWM 輸出，提供 Normal 與 Large 兩種音量大小選項；PWM1、PWM2 可直接驅動 Buzzer 或 8、16、32、64Ω Speaker。

(15)**LVR (Low Voltage Reset)**：當電壓瞬間過低時，IC 會自動重置(Reset)。

(16)**Try_Me_Mode**

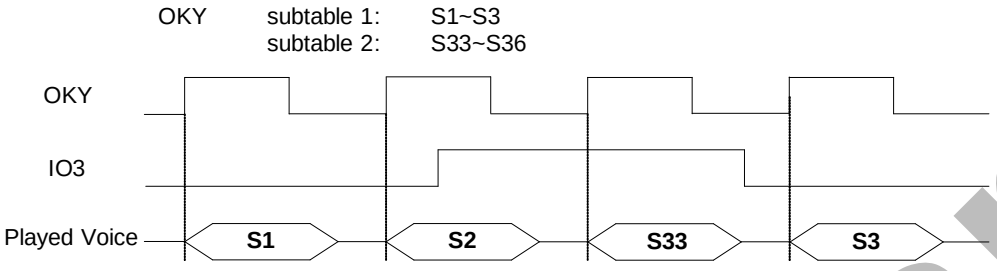
開啓 Try_Me_Mode 功能時，IO3 預設爲輸入腳(Edge / Unhold / Retrigger)，根據 IO3 選擇訊號，OKY 可分別播放兩組語音組(S1 ~ S32 及 S33 ~ S64)。

IO3	OKY Play Sub-table
IO3 接至低電位	Sub-table 1 ~ Sub-table32
IO3 接至高電位	Sub-table33 ~ Sub-table64

其時序圖的範例說明如下：

當 IO3 低電位時：觸發 OKY 所播放的語音組爲第一組(S1 ~ S3)。

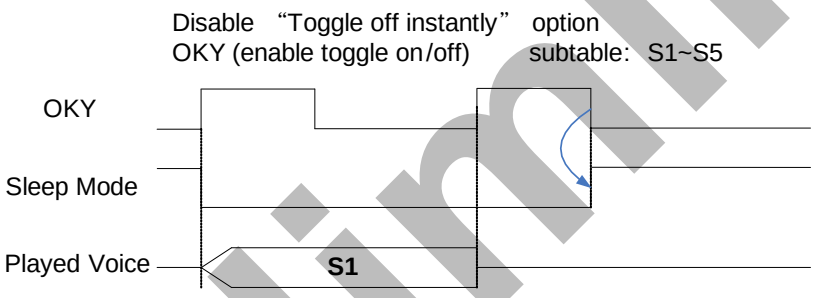
當 IO3 高電位時：觸發 OKY 所播放的語音組爲第二組(S33 ~ S36)。



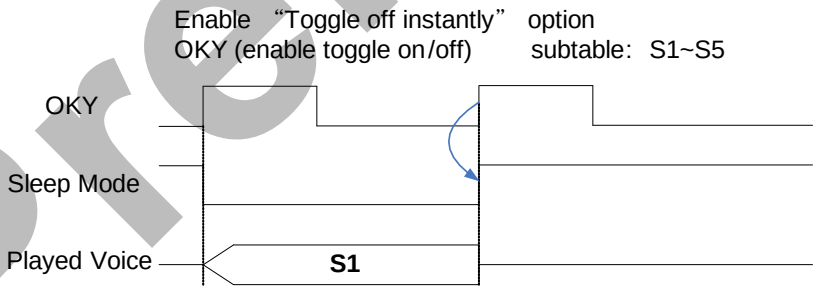
(17)**Toggle OFF instantly**

若開啓“Toggle OFF instantly”選項，當第二次按下按鍵時，IC 會於按鍵訊號的正緣立即進入睡眠模式。若沒有開啓“Toggle OFF instantly”選項，第二次按下按鍵時，IC 雖然會馬上停止 PWM 輸出但會在按鍵放開時才進入睡眠模式。

(a) 關閉 “Toggle OFF instantly” 選項：放開第二次 OKY 時，IC 才進入睡眠模式。



(b) 開啓“Toggle OFF instantly”選項：按下第二次 OKY 時，IC 立刻進入睡眠模式。

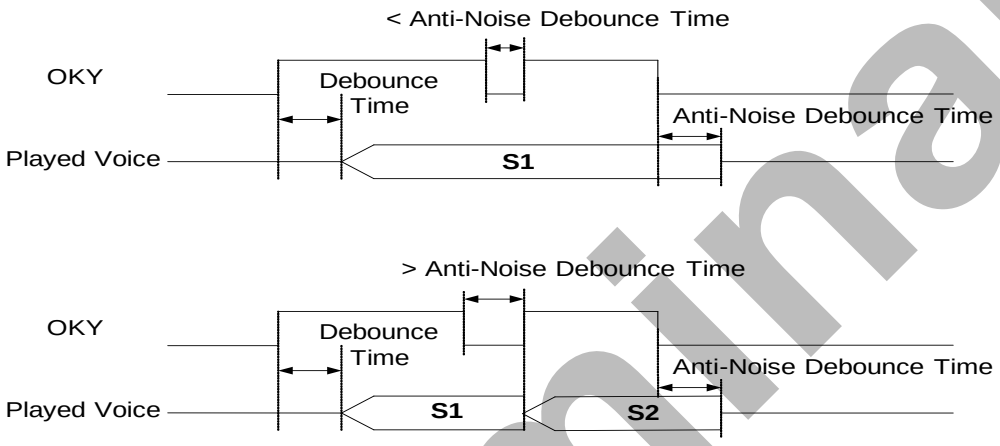


(18)**Motor Recovery**

開啓 Motor Recovery 功能時，IO2 爲產生馬達復位輸出腳位，IO3 爲偵測馬達是否回到原始位置腳位。若未回到原始位置，IO2 產生馬達復位輸出(12Hz/DC)；反之如果馬達回到原始位置或馬達復位輸出時間超過 7.93(S)，則停止馬達復位輸出(12Hz/DC) ，詳細請參考 8.8 節。

(19)**Anti-Noise Debounce**

開啓 Anti-Noise Debounce 功能時，當觸發訊號受雜訊干擾而產生低電位，若此低電位的時間小於 Anti-noise debounce time，則被判定爲雜訊，因而不會重複觸發(如圖)；反之，如果此低電位的時間大於於 Anti-noise debounce time，則會被判定成兩次觸發。



※ 125 μS < Anti-Noise Debounce Time < 250 μS

(20)**IR Received**

在 AM9DA Series 中，提供了一個"IR Received"功能，該功能利用 OKY1 pin 當接收端，使用者可利用 Alpha 的 4 bit MCU(Ex. AM4K、AM4G、AM5B…)當作發射端，傳送出所需播放的語音編碼訊號，讓 AM9DA Chip 接收語音編碼後進行播放，詳細請參考 8.9 節。

1 General Description

AM9DA Series is single-chip voice synthesizing CMOS IC. It comes with low-cost and highly applicable features and are capable of synthesizing voice up to **14, 35, 65, 130 seconds** using 4bit, 4vbit, 5bit, 6bit DPCM and PCM algorithm. Besides, this series provide five I/O pins (OKY, IO1, IO2, IO3 and IO4) and one set of PWM output for user to apply in various applications, AM9CAOTP series further comes with a built-in oscillator with high accuracy, LVR (Low Voltage Reset). To facilitate the development process, convenient software *EzSpeech* is ready for use as needed.

2 Features

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

(2) The total voice duration is about **14, 35, 65, 130** seconds that can be partitioned up to 256 voice sections. The length of each voice section is flexible.

Product	Voice Duration (sec)	I/O	Subtable	Step	Play Speed (Hz)	Factor	PIO Sync	PWM	LVR
AM9DA014x	14	1	16	256	25 types 4K~25K	1~12, PCM	—	Large	V
AM9DA035x	35	5	64				V	Normal /Large	
AM9DA065x	65	5	64				V		
AM9DA130x	130	5	64				V		

(3) At 6-KHz Sample Rate, the duration of each voice section can be individually up to **14, 35, 65, 130** seconds, and the mute length can be individually up to 43 seconds.

(4) Four SYNC signals can be edited into each voice using PowerIO Editor (5 Syncs for OKY, IO1, IO2, IO3 and IO4).

Note: AM9DA014 doesn't provide Sync signal.

(5) There are a total of 256 voice steps that can be divided into 64 subtables. The number of voice steps for each subtable is flexible, but the maximum is 256. Each voice step can be specified with one voice section, playback speed and IO1 / IO2 / IO2 / IO4 outputs enable options when they are set as output.

Note: AM9DA014 provides one output signal.

(6) The current Start subtable (Ex. S1) playback continuously, when the last voice_step of subtable are set "Loop" instruction. In last voice_step of subtable, a "Jump" instruction is available. Herein you can specify another Jump subtable (Ex. L1) next to the current subtable of Start subtable (Ex. S1) to playback continuously. Then to decide whether L1 subtable is played in loop or not, i.e. "Jump and Loop" instruction. Please refer to section 8.6 in detail.

(7) Using the special "KeyReleaseJump" function with Jumping setup, the playing Start subtable S1 will stop and immediately play associated Loop subtable L1 when key is released. User can also set Loop in L1 to play L1 in loop. Please refer to section 8.7 in detail.

(8) Support built-in variable frequency oscillator, you can choose the playback frequency within 4KHz ~ 25KHz.

Note: If the playback frequency is not set as OSC Trim frequency (within 4KHz ~ 25KHz), the +/- 3% deviation is not guaranteed.

(9) OKY, IO1, IO2, IO3 and IO4 can be either input or output.

Note: AM9DA014 provides OKY1 I/O pin only.

(10)The voice or mute duration in each voice section must be the multiples of 40 HEX.

(11)Using the special "PowerOnPlay" function, the playing POP subtable after power on. User can also set "Jumping", "Looping" or “Jumping and Looping” instruction. Please refer to section 8.6.4 in detail.

Note: For PowerOnPlay, only Edge / Unhold / Retrigger or Edge / Unhold / Irretrigger trigger modes are available.

(12)Key trigger input mode:

(a) Each input pin has a mask option for Edge/Level, Hold/Unhold and Retrigger/Irretrigger trigger modes.

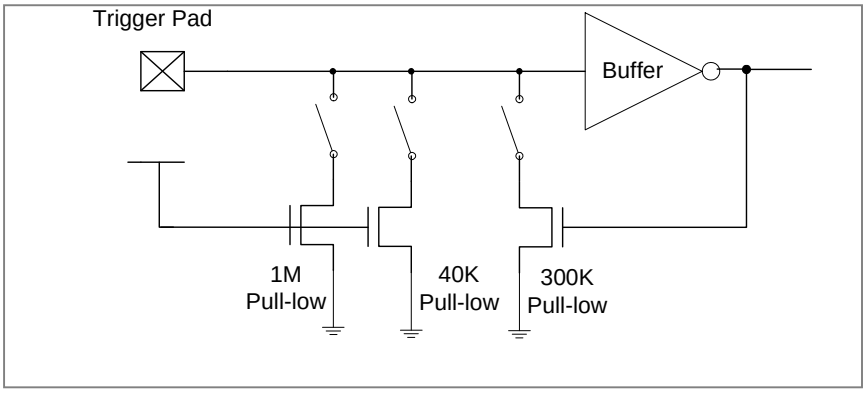
(b) OKY input can choose One-Key Sequential or Random for maximum 64 subtables. For One-Key Sequential, you can set whether or not to reset the subtable sequence when other keys are triggered.

(c) One of OKY, IO1, IO2, IO3 or IO4 input can choose to enable the Toggle On/Off function.

(d) OKY input can choose 40K pull-low, CDS+1M, CDS, 1M pull-low or floating input type. IO1, IO2, IO3 and IO4 (OKY2) input can choose CDS+1M, CDS, 1M pull-low or floating input type.

Input Types:

Option	Description
40K pull-low	Internal 40K ohms pull-low resistor, usually for large noise applications.
CDS + 1M	Normal selection for key trigger. 1M ohms pull-low resistor when key is pressed while 1M+300K ohms (parallel) pull-low resistor when key is released.
CDS	Internal 300K ohms pull-low resistor, usually used with a photoresistor.
1M pull-low	Internal 1M ohms pull-low resistor, used for some special applications.
Floating	No internal resistor connection usually connected to other output pin or connected to VSS via an external resistor.



Note: When IO1, IO2, IO3 or IO4 is set as input, the “40K ohms pull-low” option is not available.

(e) Two selectable Debounce Time for each input pin:

- Long Debounce for push buttons.
- Short Debounce for fast switches.

(f) Input pin priority：OKY > IO1 > IO2 > IO3 > IO4 (OKY2) > PowerOnPlay.

(13)7 kinds of output option for IO1, IO2, IO3 and IO4:

(a) 3 Hz flash: Output 3 Hz sink signals during voice playing at 6 KHz Sample Rate.

(b) 6 Hz flash: Output 6 Hz sink signals during voice playing at 6 KHz Sample Rate.

(c) 12 Hz flash: Output 12 Hz sink signals during voice playing at 6 KHz Sample Rate.

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

(e) Busy_Low active: Output a low active signal during voice playing.

(f) Dynamic 2/4: Output dynamic sink signals during voice playing.

(g) Power IO output: Arbitrary output with voice, user can edit the Sync signal using PowerIO Editor.

Note: 3 Hz, 6 Hz and 12 Hz flash indicate that LED flashes at a 6-KHz sample rate. The frequency of LED flash may vary depending on different sample rates.

(14)A set of 10-bit PWM output provides two types of volume options that are Normal and Large whereas PWM1 and PWM2 can drive Buzzer or 8, 16, 32 and 64Ω Speaker directly.

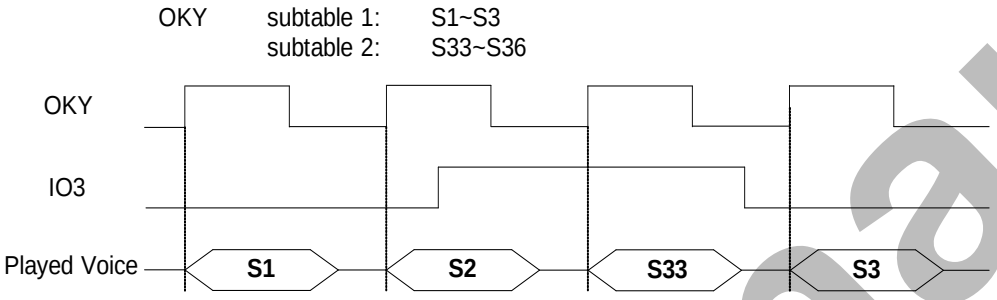
(15)**LVR (Low Voltage Reset)**: IC will reset when its operation voltage drops too low.

(16)**Try_Me_Mode**

When Try_Me_Mode is enabled, IO3 is defaulted as an input pin (Edge / Unhold / Retrigger), and OKY can be set with two subtables (S1 ~ S32 and S33 ~ S64). Here uses IO3 to select subtables, the timing diagram and description are as follows:

IO3 in low voltage: Trigger OKY to play the first subtable (S1 ~ S3) sequentially.

IO3 in high voltage: Trigger OKY to play the second subtable **(S33 ~ S36)** sequentially.

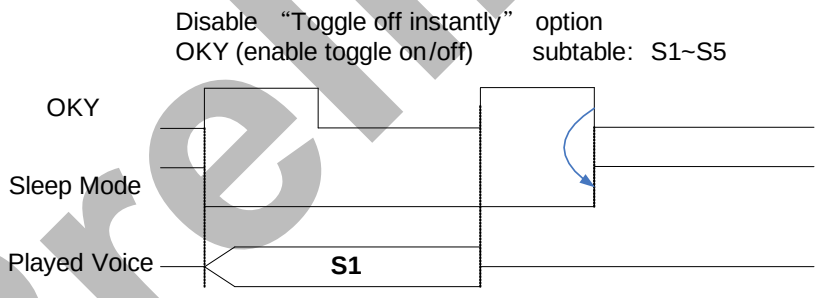


(17)**Toggle OFF instantly**

When the “Toggle OFF instantly” option is enabled, IC will enter Sleep Mode immediately at the positive edge of the second key-press signal. On the other hand, when the “Toggle OFF instantly” option is disabled, IC will stop PWM output immediately at the second key-press, yet will not enter Sleep Mode until the key is released.

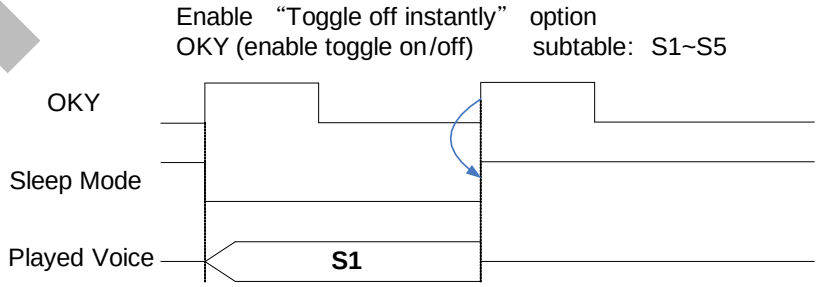
(a) Disable the “Toggle OFF instantly” option:

IC enters Sleep Mode when the second OKY is released.



(b) Enable the “Toggle OFF instantly” option:

IC enters Sleep Mode immediately when the second OKY is pressed.

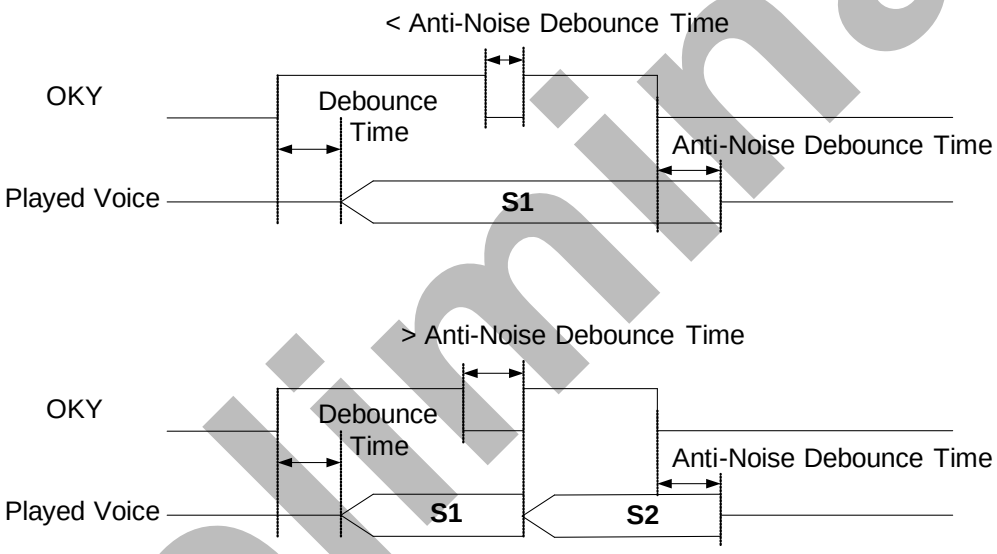


(18)**Motor Recovery**

When enable "Motor Recovery" function, IO2 is defaulted as an output pin which generates motor recovery output, IO3 is defaulted as an input pin which detects the motor comes back initial position or not. If the motor doesn't come back the initial position, IO2 generates motor recovery output (12Hz/DC). Conversely if the motor comes back the initial position or the time of motor recovery output exceed 7.93 second, IO2 stops generating motor recovery output (12Hz/DC). Please refer to section 8.8 in detail.

(19)**Anti-Noise Debounce**

When enable "Anti-Noise Debounce" function, the input trigger signal are affected to generate low-level signal by noise. If the time of low-level signal is shorter than anti-noise debounce time, then it is regarded as noise. The input signal doesn't trigger again. Conversely if time of low-level signal is longer than anti-noise debounce time, the input signal is regarded as twice triggers.

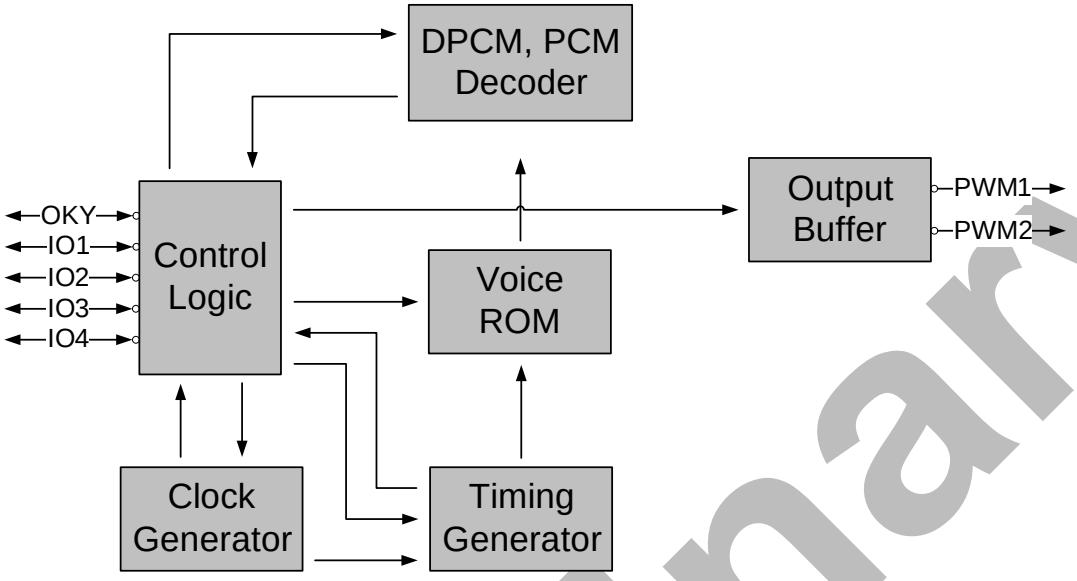


※ 125 μS < Anti-Noise Debounce Time < 250 μS

(20)**IR Received**

When enable "IR Received" function, OKY is defaulted as an input pin (Edge / Unhold / Retrigger) which IR Received, and set with Short Debounce as well as Floating. IC plays the corresponding sub-table after transmitter transmits the IR codes to IC (should use Alpha 4 bit MCU). IC provides "Single IR Code Transmitted" and "Double IR Code Transmitted" mode because of transmitting immediately and correctly. Please refer to section 8.9 in detail.

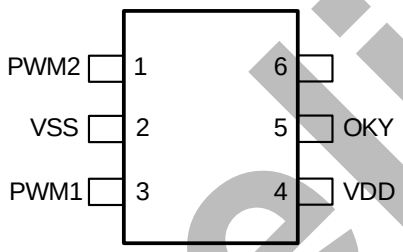
3 Block Diagram



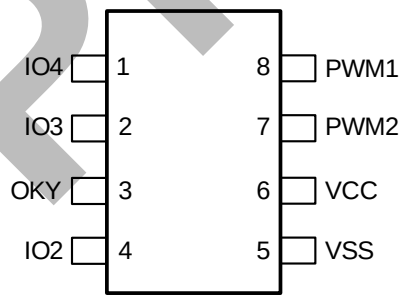
4 Pin Configuration and Pin Description

4.1 Pin Configuration

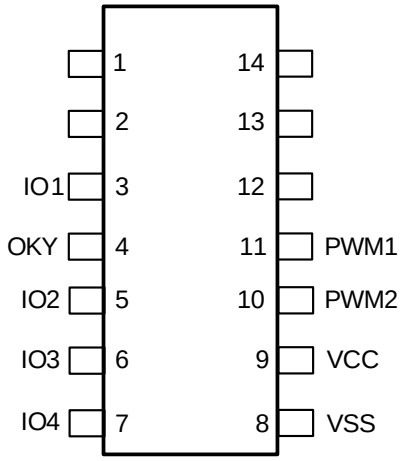
6 Pin – AM9DA014x SOT



8 Pin – AM9DA130x/AM9DA065x/AM9DA035x SOP & PDIP



14 Pin – AM9DA130x/ AM9DA065x/AM9DA035x SOP & PDIP



4.2 Pin Description

AM9DA014x Chip

Pad Name	Pad No.	ATTR.	Function
OKY	1	I/O	Status output or input for trigger.
VSS	2	Power	Negative power supply.
VCC	3	Power	Positive power supply.
PWM1	4	O	Audio output.
PWM2	5	O	Audio output.

AM9DA035x/AM9DA065x/AM9DA130x Chip

Pad Name	Pad No.	ATTR.	Function
OKY	1	I/O	Status output or input for trigger.
IO1	2	I/O	Status output or input for trigger.
IO2	3	I/O	Status output or input for trigger.
IO3	4	I/O	Status output or input for trigger.
IO4	5	I/O	Status output or input for trigger.
VSS	6	Power	Negative power supply.
VCC	7	Power	Positive power supply.
PWM1	8	O	Audio output.
PWM2	9	O	Audio output.

5 Code Development and Demo System

User can use *EzSpeech* software tool to develop the desired functions. For details, please refer to *EzSpeech* User Manual. After finishing the code programming, two files of .eva and .htm, one binary file and a function check list will be generated. User can download the .eva file into AM9DA_DB demo board to demonstrate the AM9DA function.

	AM9DA Chip/AM9DA_DB	Description
I/O Pin	OKY, IO1, IO2, IO3, OKY2/IO4	OKY, IO1, IO2, IO3, IO4 can be either a status output or a trigger input.
	PWM1, PWM2	PWM output to directly drive speakers.

For some input types, user may need to connect an external resistor first. Please see the table below.

	AM9DA Chip/AM9DA_DB	Description
Input Type	CDS + 1M	Normal selection for key trigger. 1M ohms pull-low resistor when key is pressed while 1M+300K ohms (parallel) pull-low resistor when key is released.
	CDS	Internal 300K ohms pull-low resistor is usually used with a photo resistor.
	40K pull-low	Internal 40K ohms pull-low resistor is usually used for large noise applications.
	1M pull-low	Internal 1M ohms pull-low resistor is used for some special applications.
	Floating	No internal resistor connection. It is usually connected to other output pin or connected to VSS via an external resistor.

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} ~ V_{CC}	-0.5 ~ +7.0	V
V_{in}	V_{SS}-0.3 < V_{in} < V_{CC}+0.3	V
V_{out}	V_{SS} < V_{out} < V_{CC}	V
T_{op} (operating)	0 ~ +70	ºC
T_{ST} (storage)	-25 ~ +85	ºC

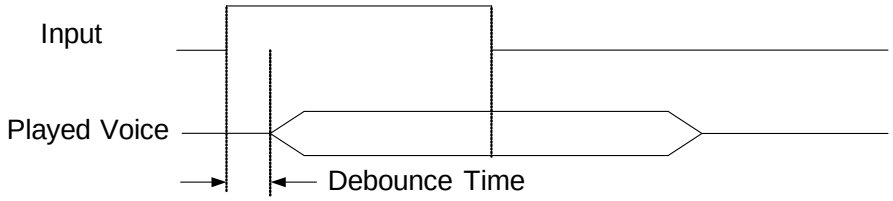
7 DC Characteristics

Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
VCC	Operating voltage		2.2	3.0	5.5	V	
Fosc	Operating Frequency		1.275	1.5	1.725	MHz	Playback Speed: 4 KHz ~ 25 KHz
Isb	Supply current	Sleep			1	uA	V_{CC} = 3 V
					2		V_{CC} = 4.5 V
Iop		Operating		2.5		mA	V_{CC} = 3 V, 6 KHz S.R.
				3			V_{CC} = 4.5 V, 6 KHz S.R.
Iih	Input current (40K pull low)			100		uA	V_{CC} = 3 V
	Input current (1M pull low)			3		uA	V_{CC} = 3 V
	Input current (CDS)			10		uA	V_{CC} = 3 V
Ipwm	PWM output current		100			mA	Vcc=3V, Load = 8 ohm
Ioh	OKY, IO1, IO2, IO3, IO4 Output Current (Normal)			-1.9		mA	V_{CC} = 3 V, Vop = 2.6 V
				-4.9			V_{CC} = 4.5 V, Vop = 3.7 V
Iol				6.6			V_{CC} = 3 V, Vop = 0.4 V
				13			V_{CC} = 4.5 V, Vop = 0.8 V
Iol	OKY, IO1, IO2, IO3, IO4 Output Current (Large)			16		mA	V_{CC} = 3 V, Vop = 0.4 V
				33			V_{CC} = 4.5 V, Vop = 0.8 V
dF/F	Frequency Stability			3		%	$\frac{Fosc(3\ V)-Fosc(2.4\ V)}{Fosc(3\ V)}$
dF/F	Frequency Stability			3		%	$\frac{Fosc(4.5\ V)-Fosc(3\ V)}{Fosc(3\ V)}$
dF/F	Fosc lot variation		-1.5		1.5	%	V_{CC} = 3 V

8 Timing Diagram

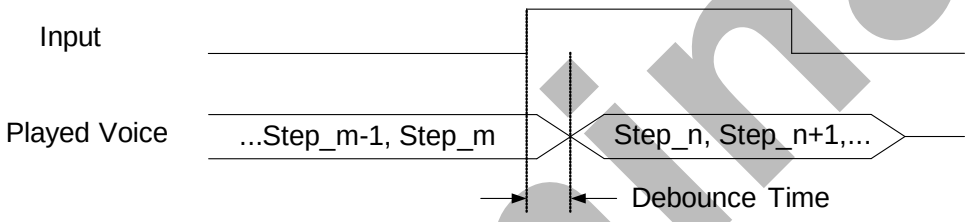
8.1 Debounce Time

(1) Trigger while no voice is played



※ Debounce Time depend on sample rate and voice algorithm, as follow

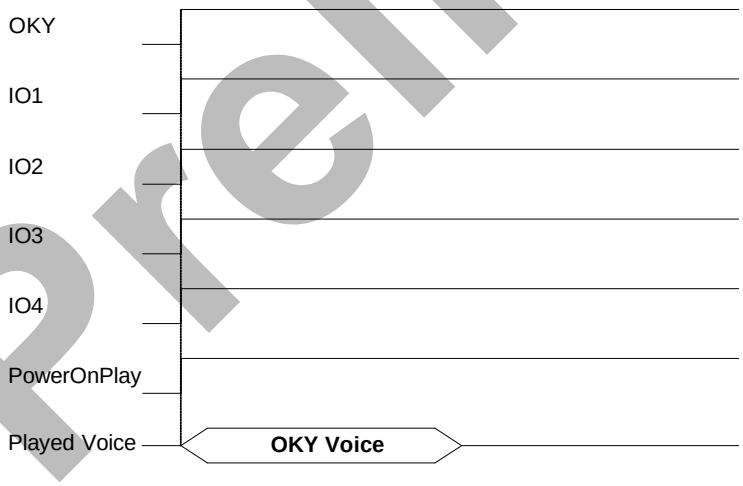
(2) Trigger while voice is being played



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

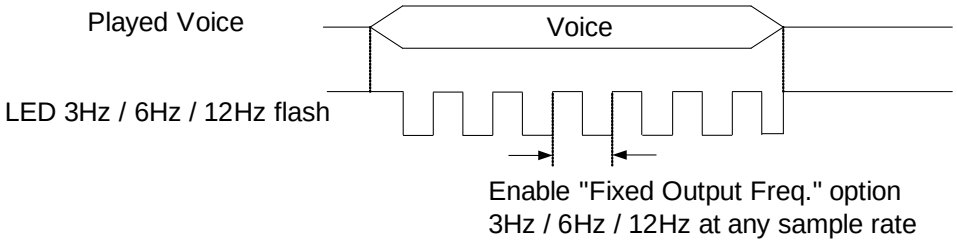
e.g.: if Step_m S.R.=8 KHz, 4DPCM algorithm, Slow Debounce=(1/ 8k) x 2^7 ms=16 ms while Fast Debounce = (1/8k)/4 ms =31.5 us.

8.2 Input Priority



※ Priority: OKY > IO1 > IO2 > IO3 > IO4(OKY2) > PlayOnPlay

8.3 Status Output (OKY & IO1 & IO2 & IO3 & IO4)



※ 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.

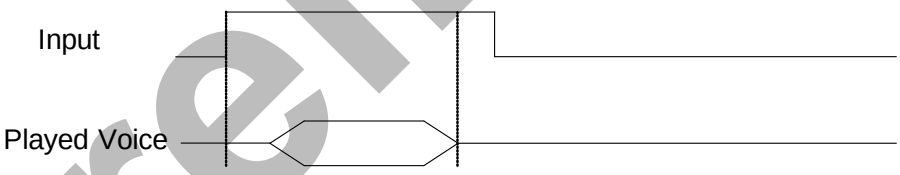
※ Power IO: Arbitrary output with voice, user can edit the Sync signal by PowerIO editor.

※ The LED 3Hz / 6Hz / 12Hz flash frequency depend on sample rate and voice algorithm when “Fixed Output Freq. ”Option” is disabled, as follow:

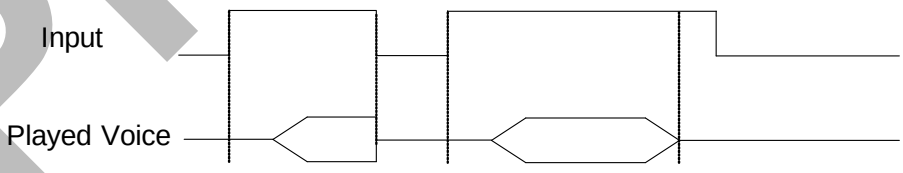
8.4 General Timing Diagram

(1) Edge Mode, Edge Trigger

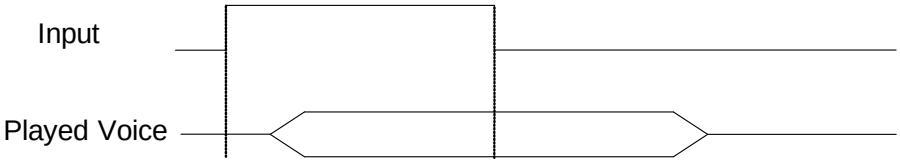
(2) Edge Mode, Level Trigger



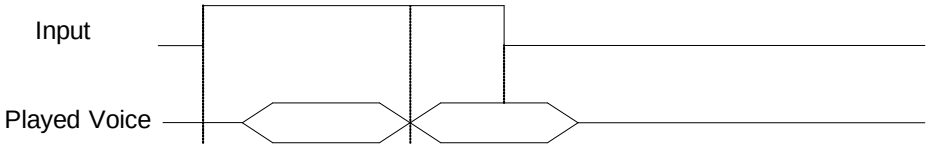
Edge/Hold



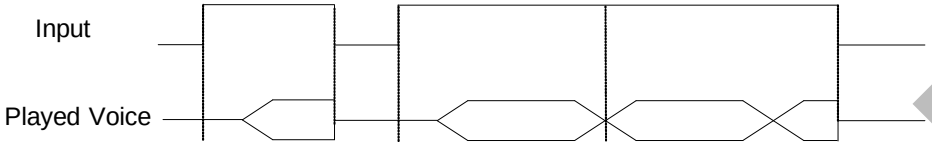
(3) Level Mode, Edge Trigger



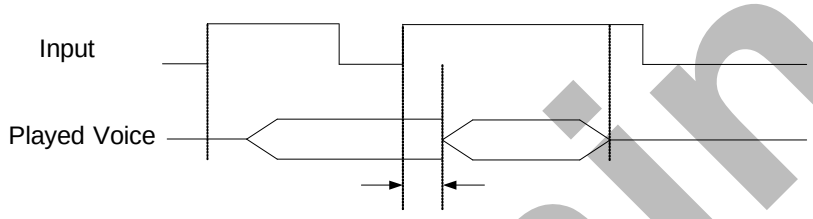
(4) Level Mode, Level Trigger



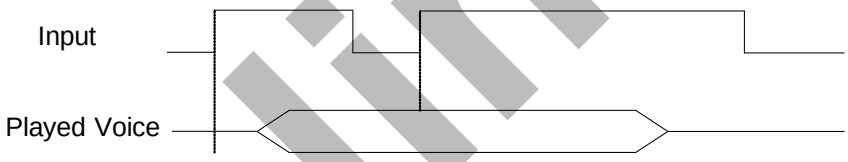
Edge/Hold



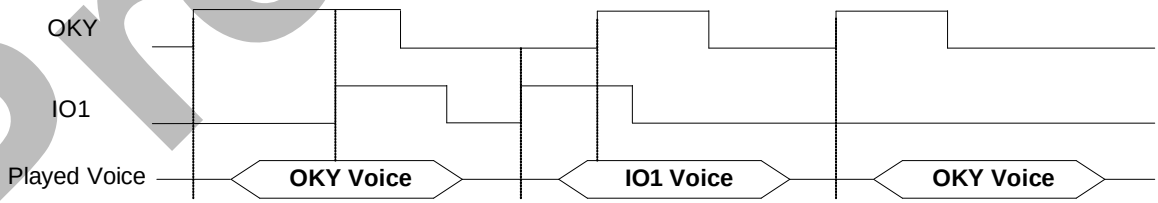
(5) Retrigger Mode



(6) Irretrigger Mode



(7) Retrigger Mode, First Key Priority



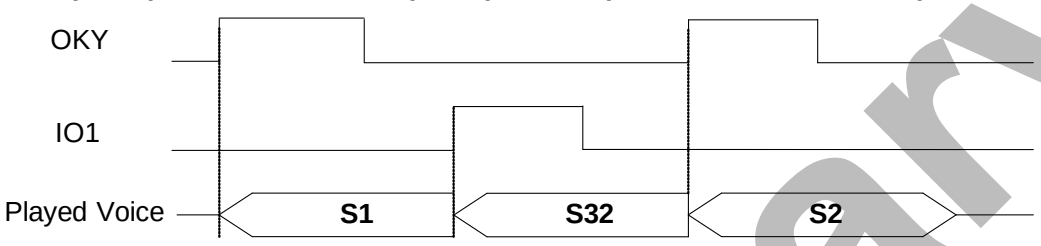
8.5 Special Timing Diagram

Debounce Time is ignored in the following diagrams.

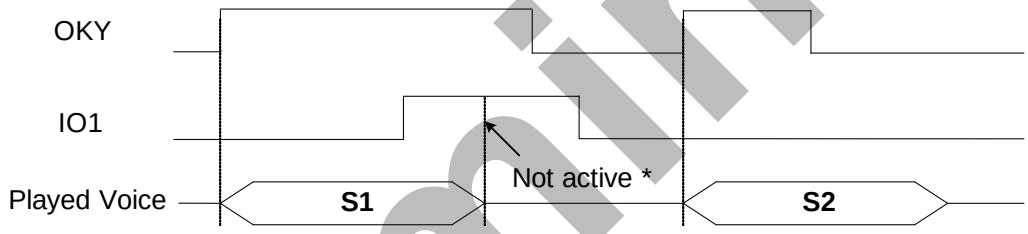
※ E, L, U, R, I as indicated below respectively stand for the triggering modes of Edge, Level, Unhold, Retrigger and Irretrigger.

(1) Different Input Reload

(a) OKY (E/U/R) = S1 S2 S3 S4, IO1 (E/U/R) = S32 (S1 stands for subtable 1)

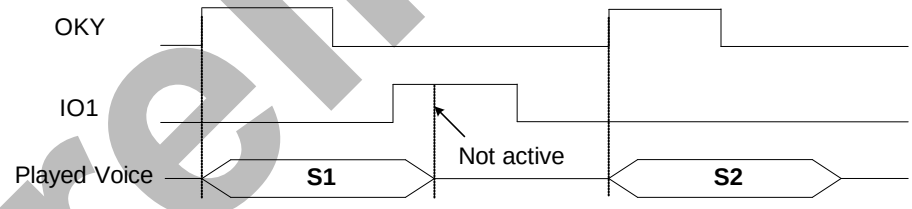


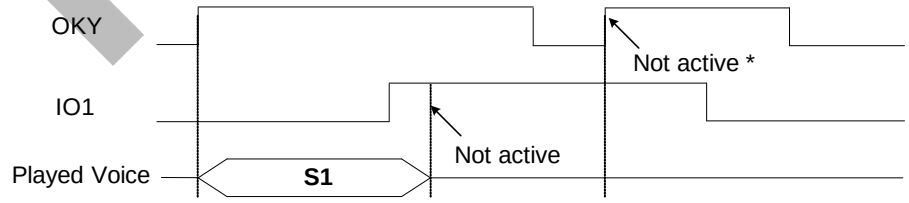
(b) OKY (E/U/R) = S1 S2 S3 S4, IO1 (L/x/x) = S32



※ Reload key priority: OKY > IO1

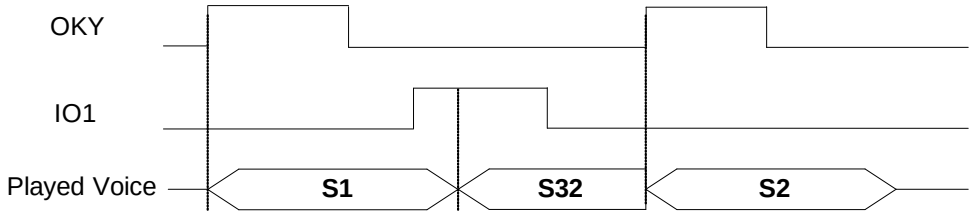
(c) OKY (E/U/I) = S1 S2 S3 S4, IO1 (E/x/x) = S32



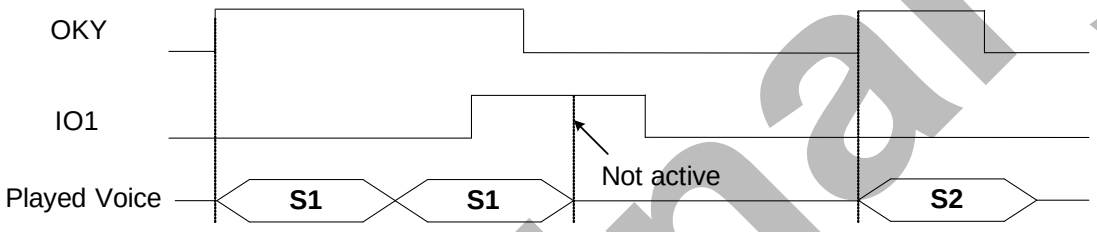


※ Because IO1 signal is still in high level, the OKY Edge signal is not active.

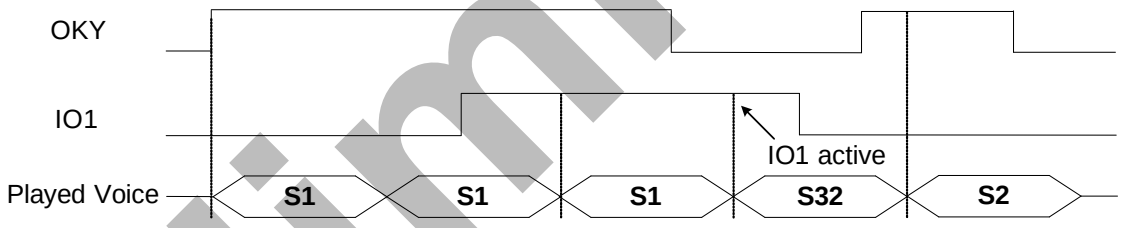
(d) OKY (E/U/I) = S1 S2 S3 S4, IO1 (L/U/R) = S32



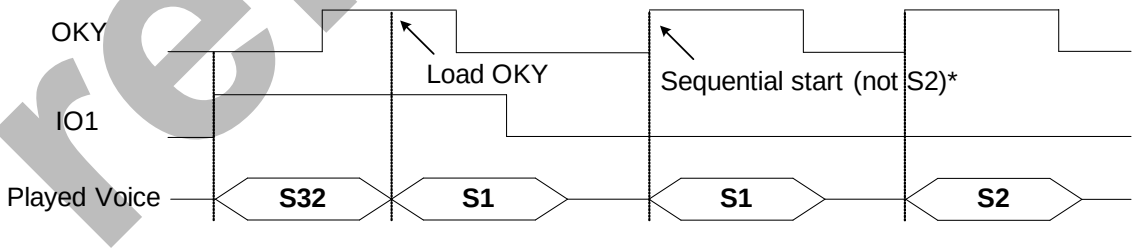
(e) OKY (L/U/x) = S1 S2 S3 S4, IO1 (E/x/x) = S32



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



※ Reload key priority: OKY > IO1



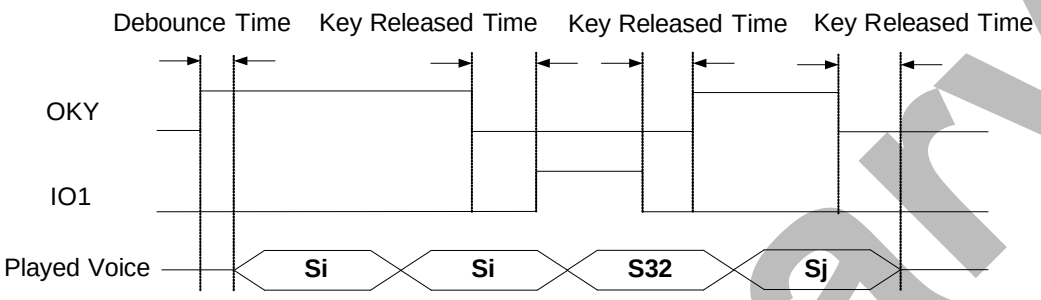
※ In OKY, 1st debounce occurs and then S1 starts playing. That is, OKY Sequential number is counted only when debounce occurs.

※ When IO1 has been triggered and starts its voice playing, triggering OKY won't be followed by a sequential trigger because no debounce occurs.

(2) Random Function

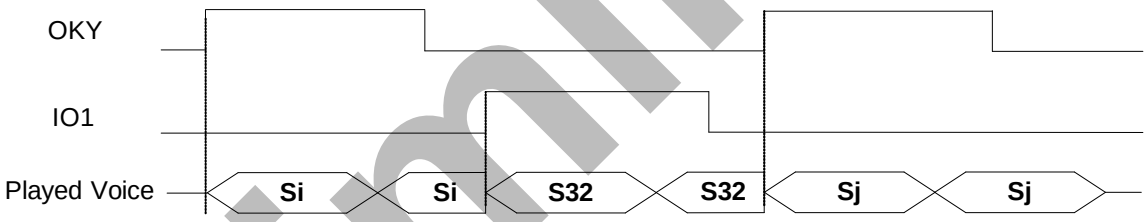
(a) OKY (L/U/I) = S1 S2 S3 S4, IO1 (L/U/I) = S32

Random number is counted at Debounce Time and during voice playing when input key is released. The first trigger only counts Debounce Time because there is no key-released time.



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

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



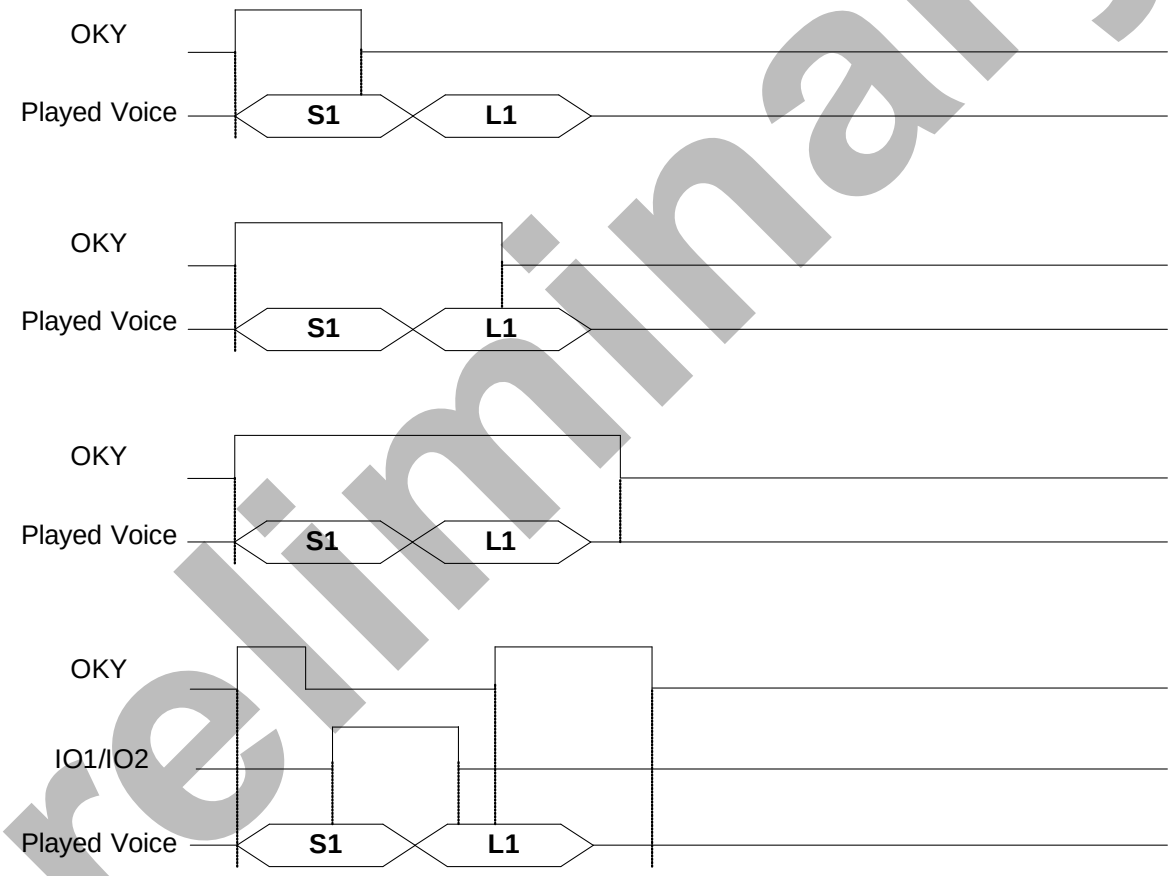
※ i=1 or 2 or 3 or 4; j=1 or 2 or 3 or 4 (i and j are random number)

8.6 Jump and Loop Function

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

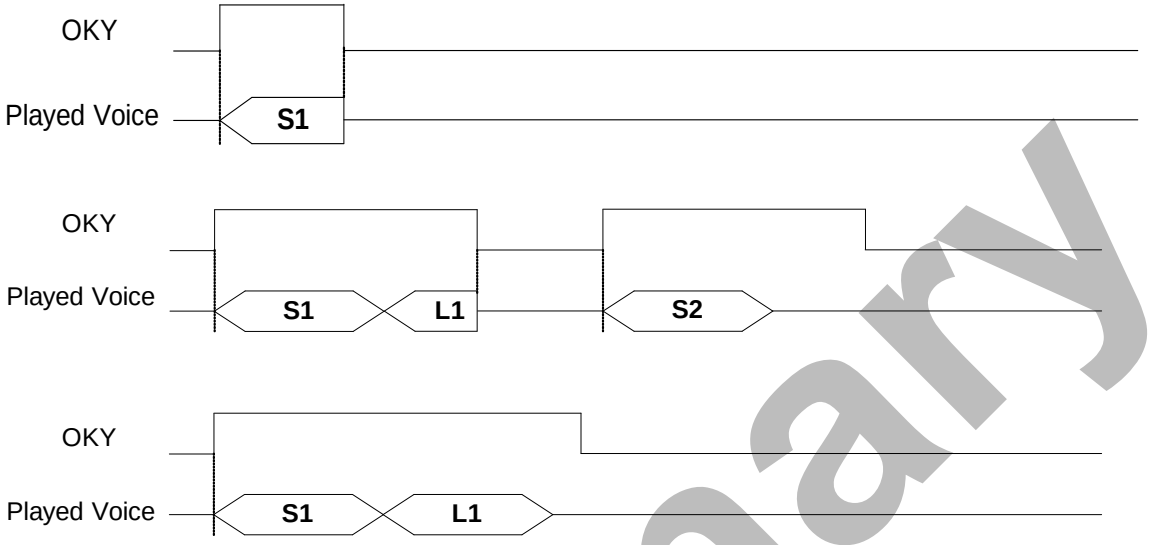
1) S1 is set Jumping without Loop

(a) OKY(E/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32, IO2 (x/x/x) = S31 (L1 means the Jump subtable of S1)

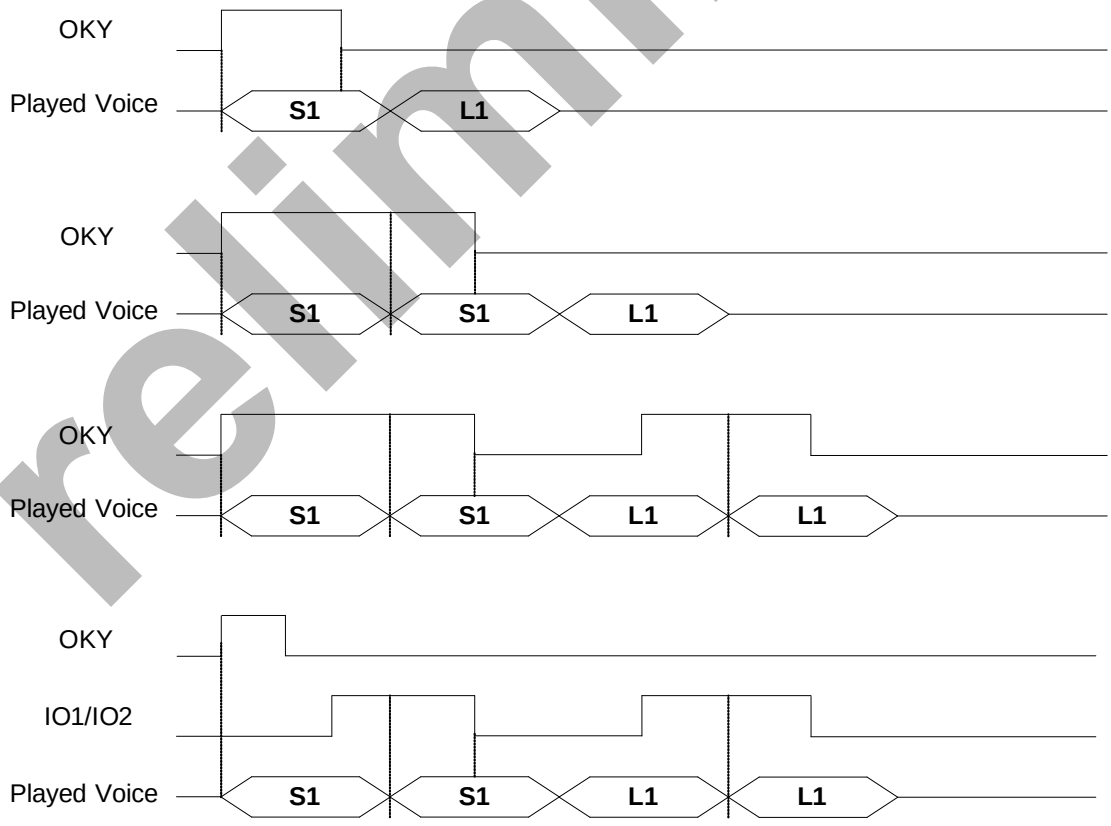


※ While playing OKY's voice (S1 or L1), to trigger OKY or IO1 is not active at Edge/Irretrigger mode.

(b) OKY (E/H/x) =S1 L1 S2 S3 (L1 means the Jump subtable of S1)

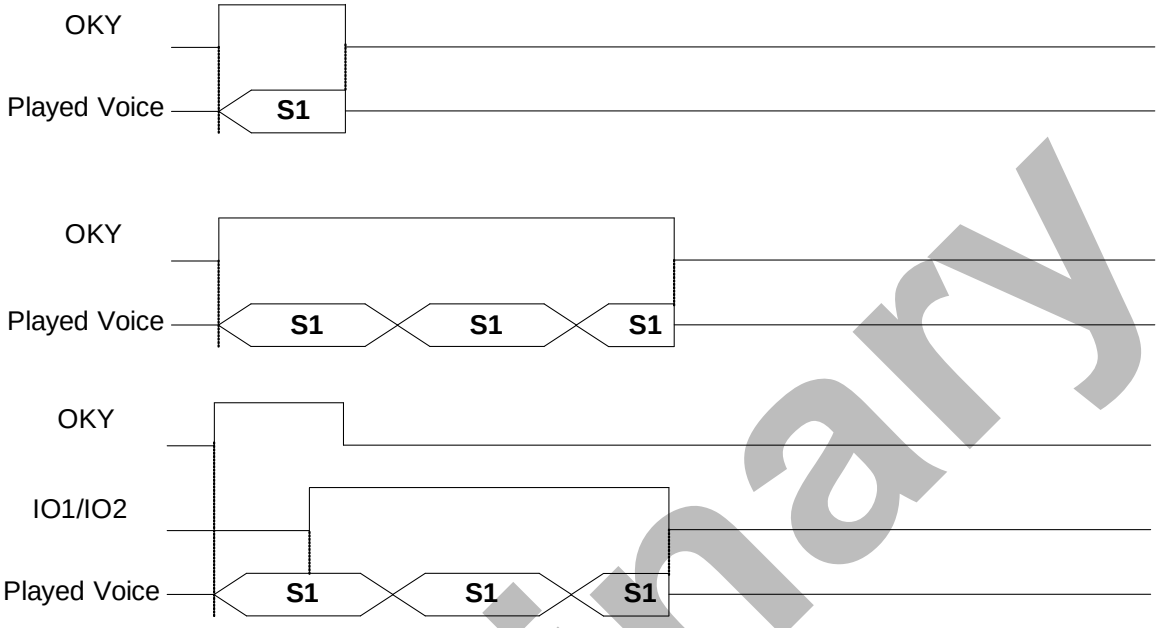


(c) OKY (L/U/I) =S1 L1 S2 S3, IO1 (L/U/I) = S32 (L1 means the Jump subtable of S1)



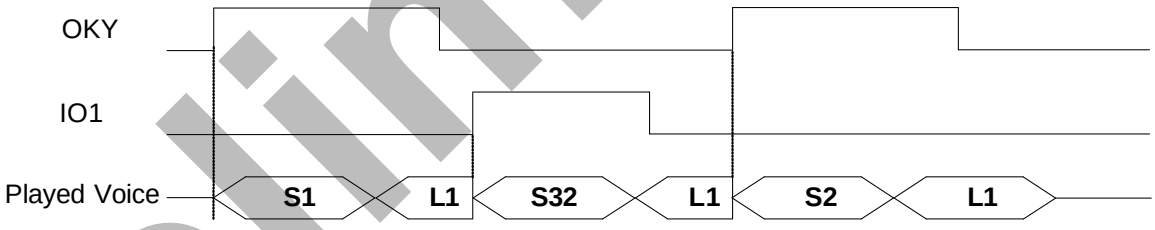
※ Without Different Input Reload, while playing OKY's voice, to trigger IO1 is recognized as to trigger OKY.

(d) OKY(L/H/x) =S1 L1 S2 S3, IO1 (x/x/x) = S32 (L1 means the Jump subtable of S1)



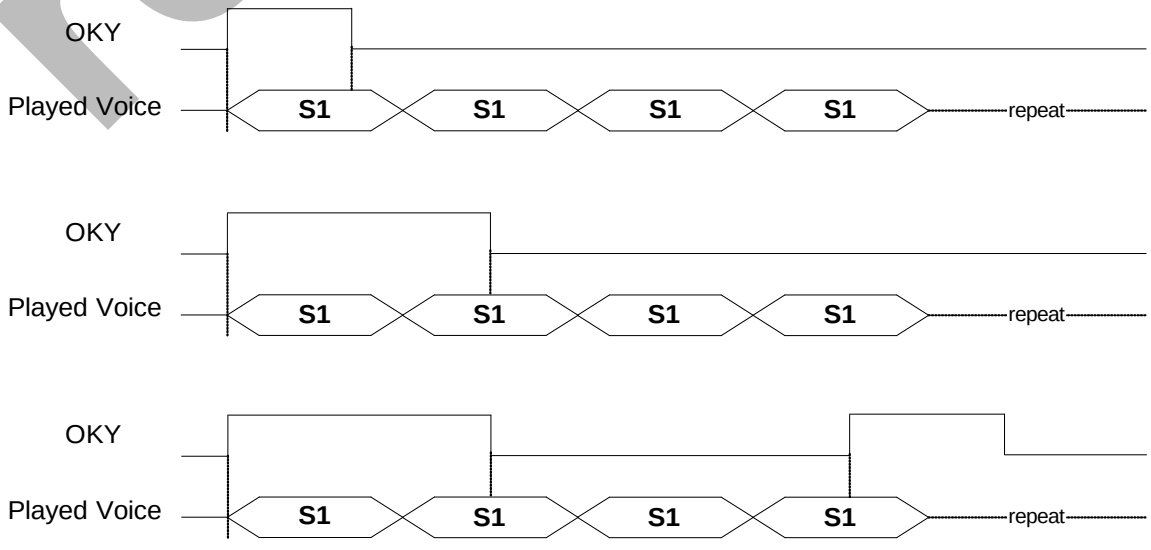
※ Without Different Input Reload, while playing OKY's voice, to trigger IO1 is recognized as to trigger OKY.

(e) OKY (E/U/R) = S1 L1 S2 L1 , IO1 (E/U/R) =S32 L1

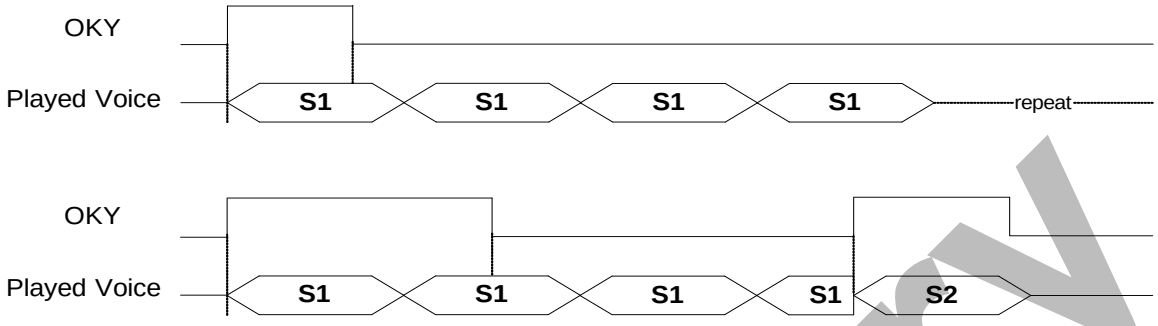


2) S1 is set Looping without Jump

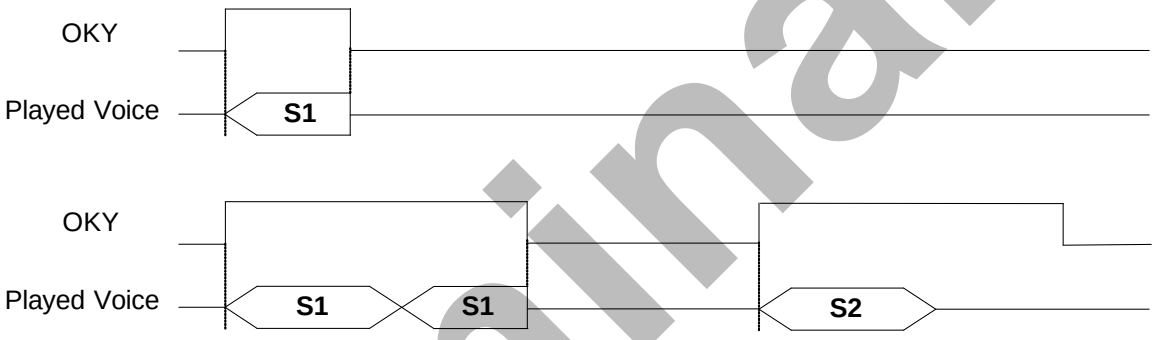
(a) OKY (x/U/I) =S1 S2 S3



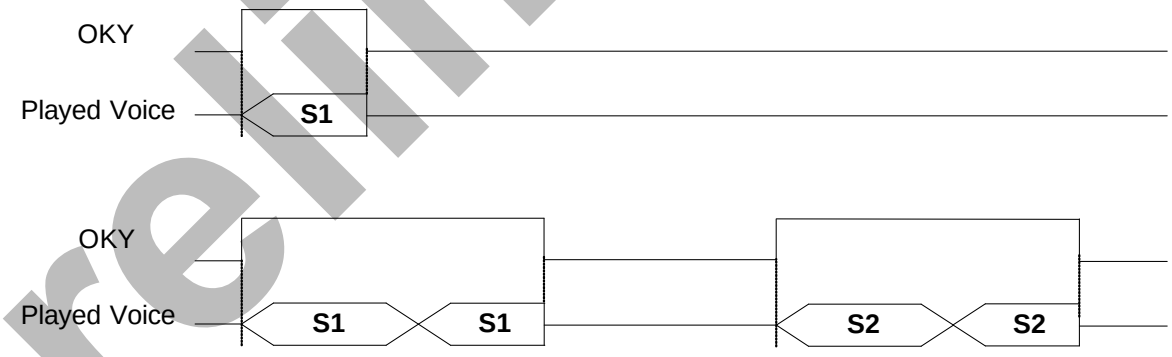
(b) OKY (x/U/r) =S1 S2 S3



(c) OKY (E/H/x) =S1 S2 S3



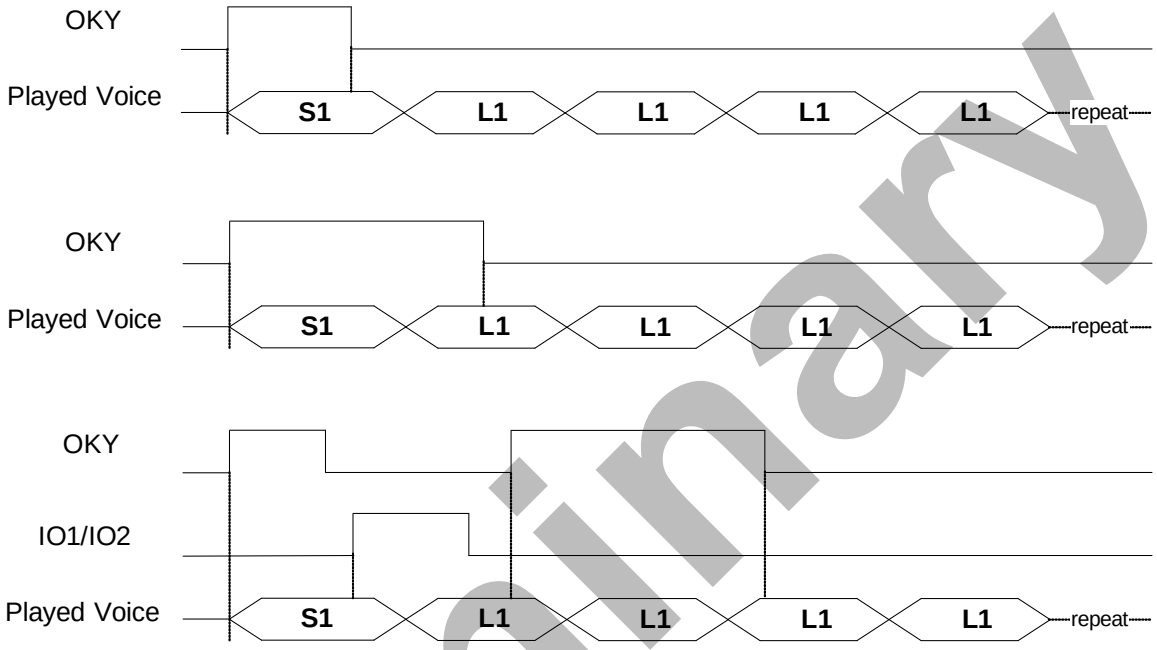
(d) OKY (L/H/x) =S1 S2 S3



3) S1 is set Jumping with Loop

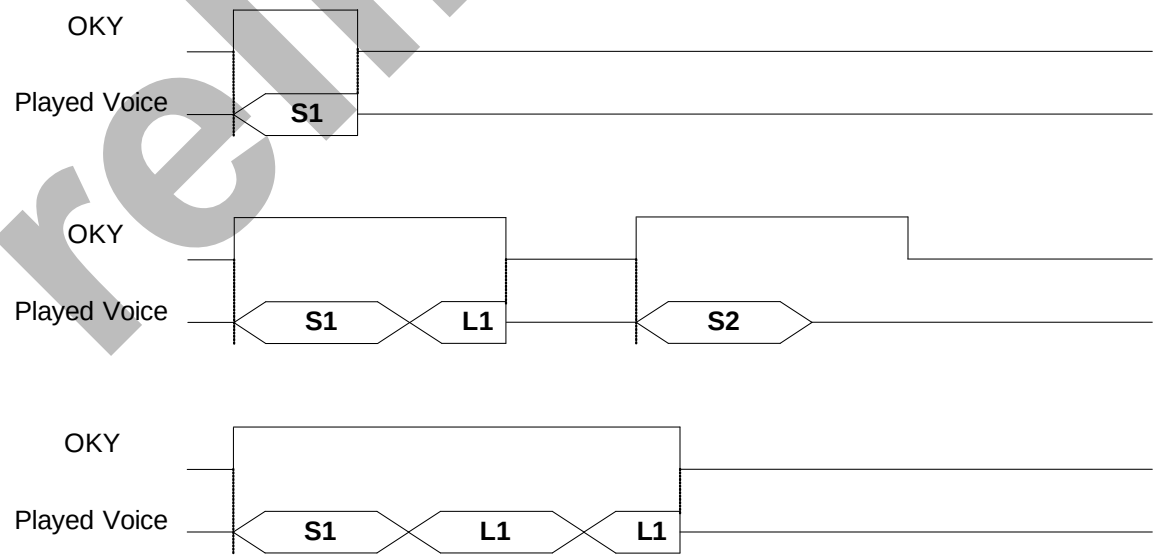
The timing diagram is similar with (8.6-1) “Jumping without Looping” except the last self-looping.

(a) OKY (E/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32, IO2 (x/x/x) = S31

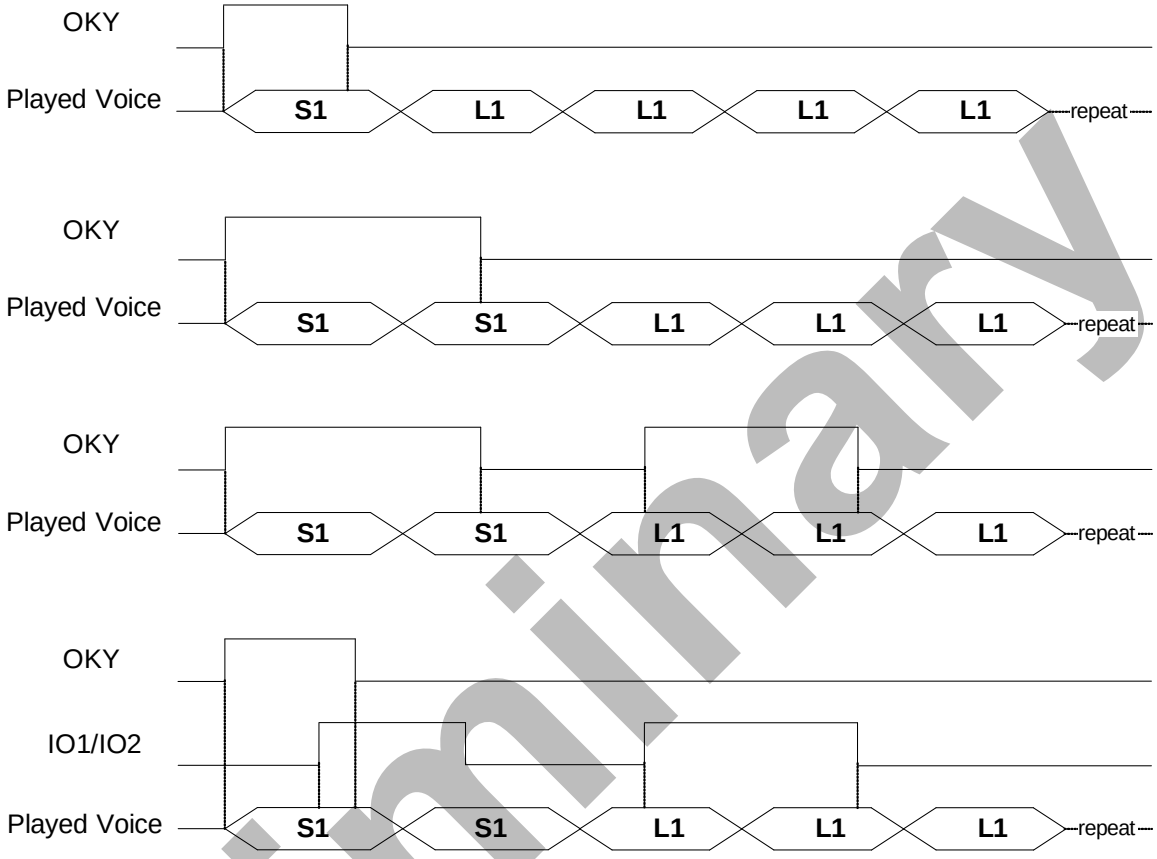


※ While playing OKY’s voice (S1 or L1), to trigger OKY or IO1 is not active at Edge/Irretrigger mode.

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

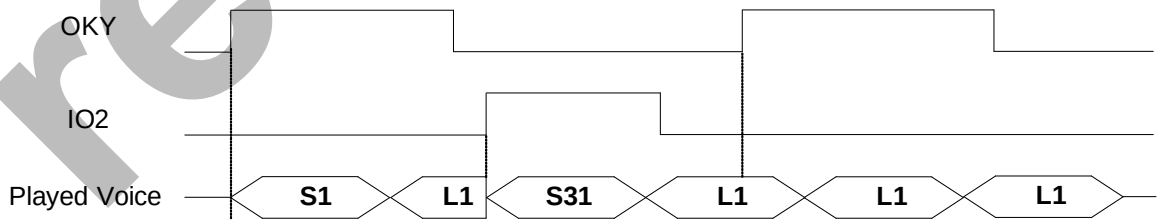


(c) OKY (L/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32, IO2 (x/x/x) = S31

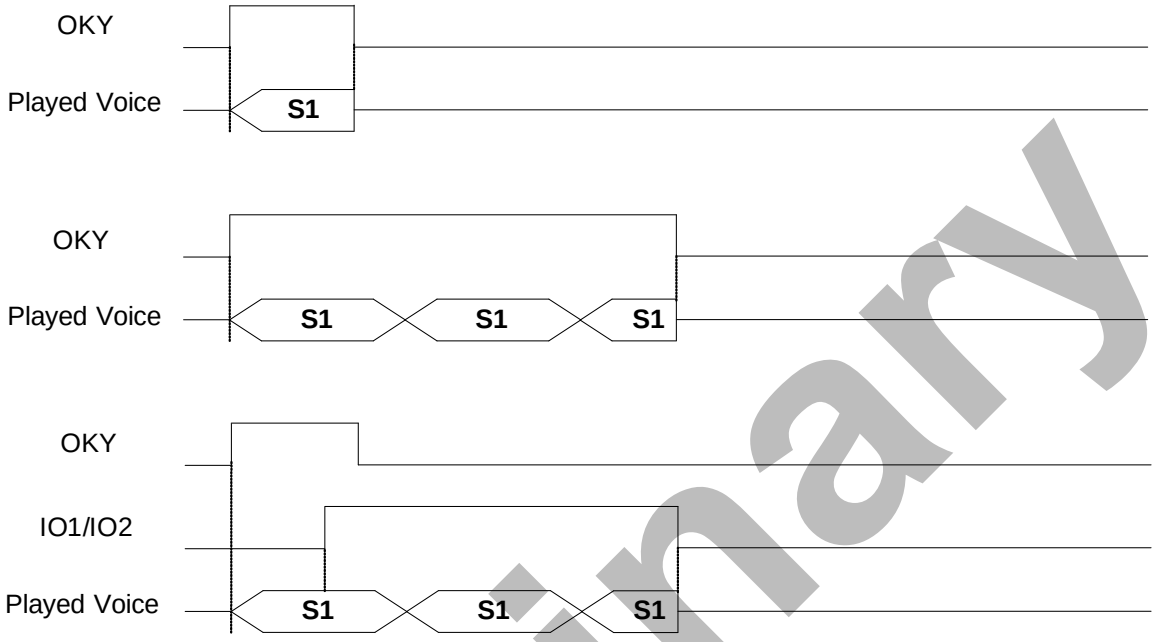


※ While playing OKY's voice, to trigger IO1 is recognized as to trigger OKY. Reload function doesn't work.

(d) OKY (E/U/R) =S1 L1, IO2 (E/U/I) =S31 L1



(e) OKY (L/H/x) =S1 L1 S2 S3, IO1 (x/x/x) = S32, IO2 (x/x/x) = S31



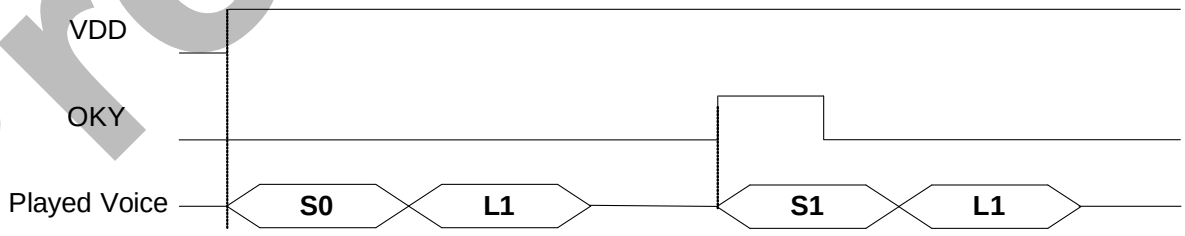
※ Without Different Input Reload, while playing OKY's voice, to trigger IO1 is recognized as to trigger OKY.

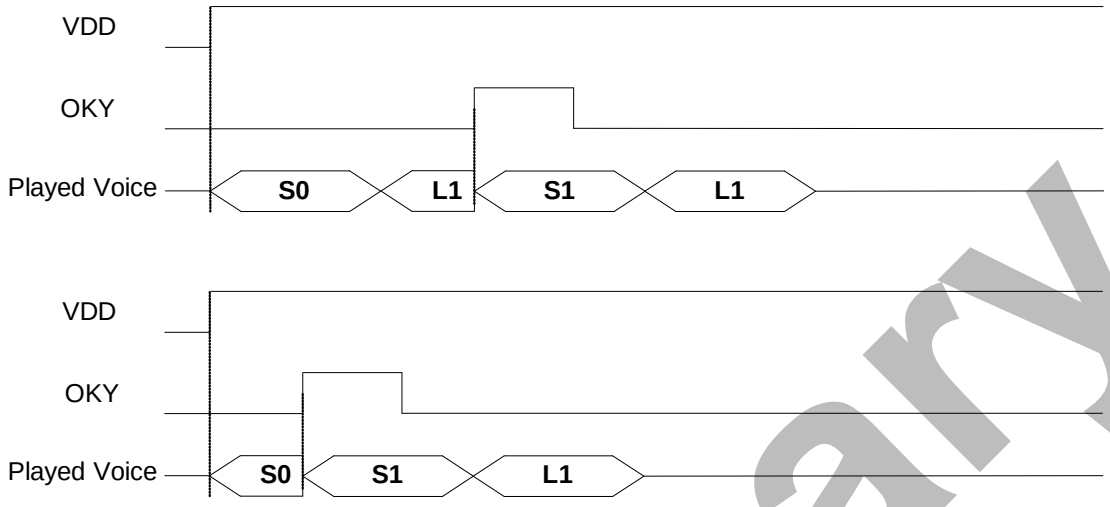
4) PowerOnPlay is set Jump without Loop, Jump with Loop

The trigger mode of PowerOnPlay is either as E/U/R or E/U/I. When the trigger mode is 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. On the contrary, the any trigger is not active during PowerOnPlay's voice when the trigger mode of PowerOnPlay is E/U/I

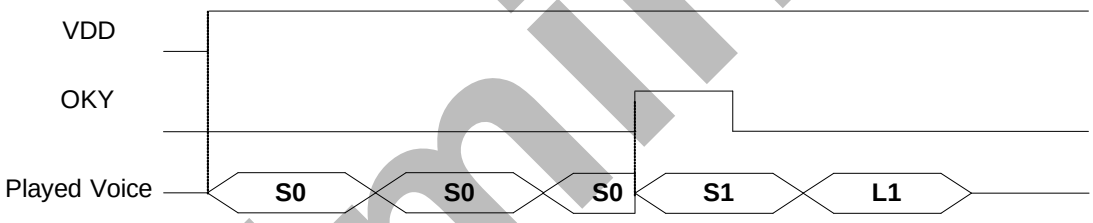
PowerOnPlay (E/U/R) =S0 L1, OKY(L/U/I) = S1 L1 S2 S3,

(a) S0 and S1 are set Jump without Loop

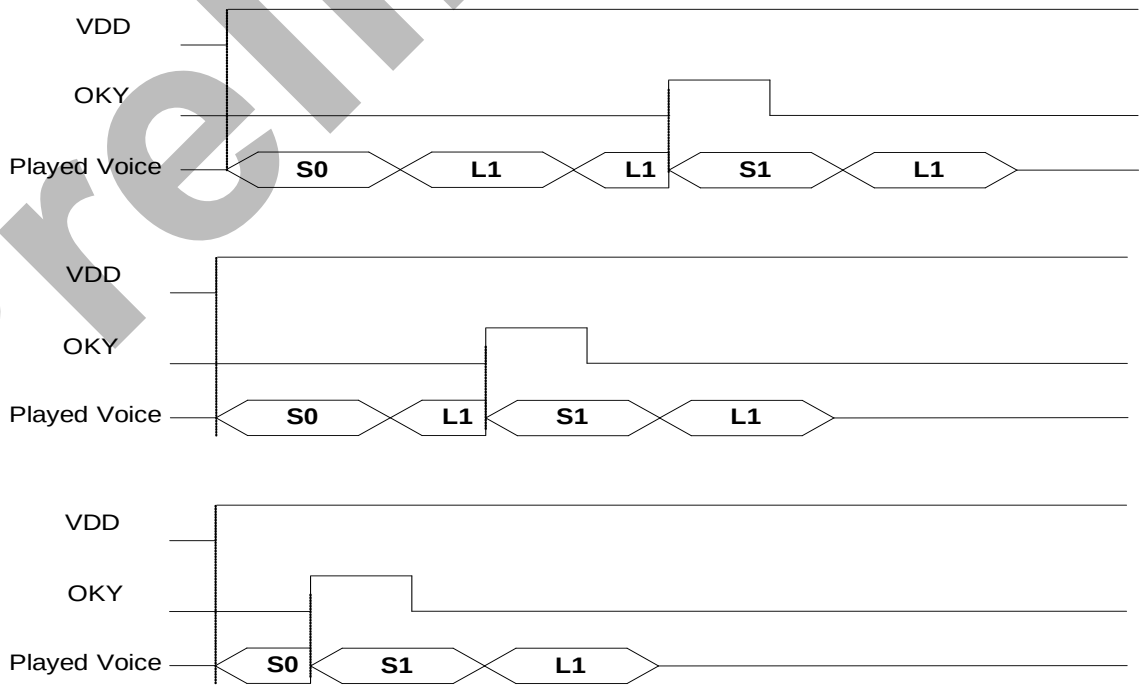




(b) S0 is set Looping without Jump, S1 is set Jumping without Loop



(c) S0 is set Jumping with Loop, S1 is set Jump without Loop

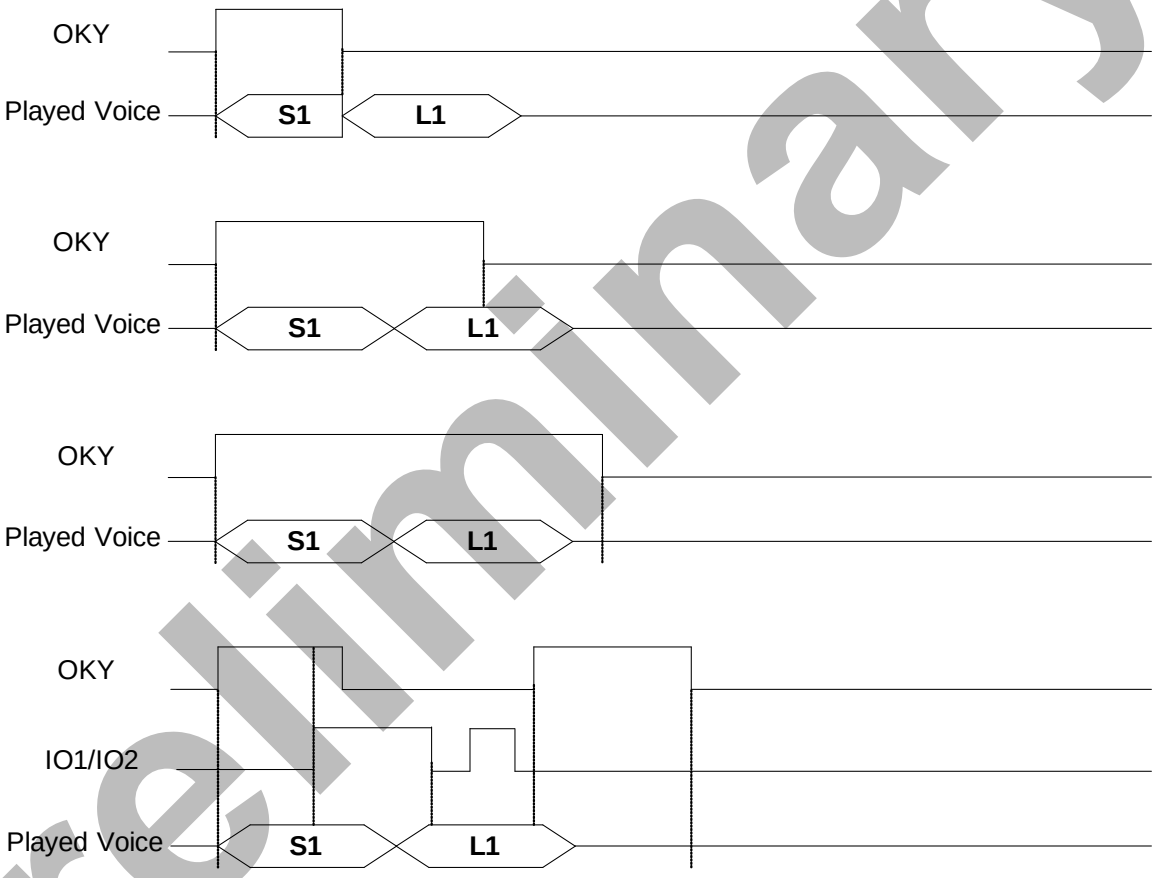


8.7 KeyReleaseJump Function

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 Jump sub-table. When tick this option, all input pins are in KeyReleaseJump condition.

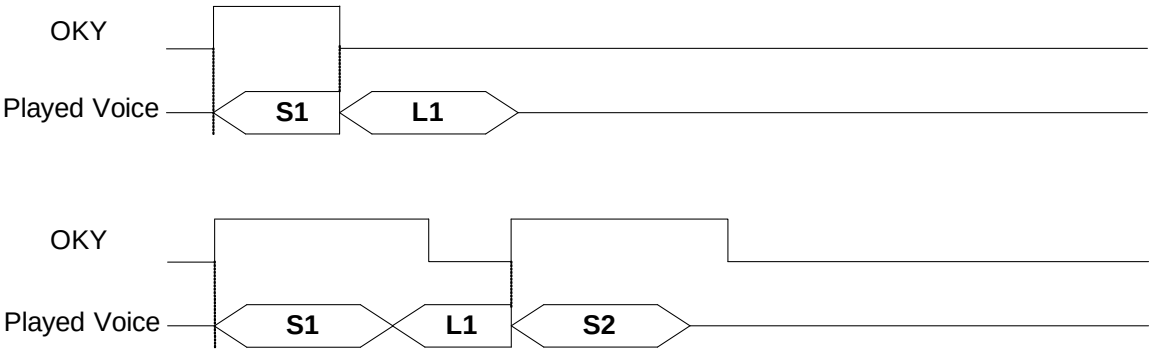
1) KeyReleaseJump with Jumping and without Loop

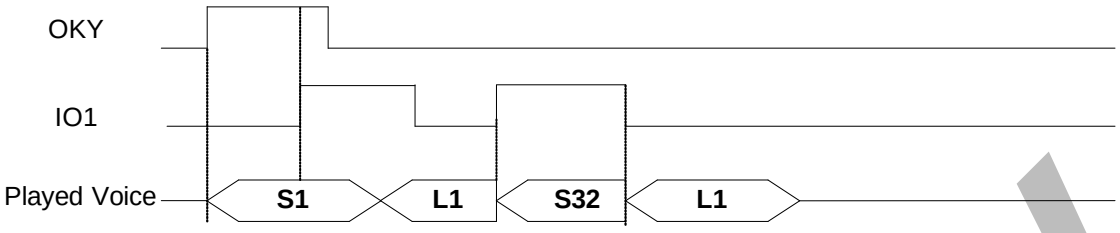
(a) OKY (E/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32, IO2 (x/x/x) = S31 (L1 means the Jump subtable of S1)



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

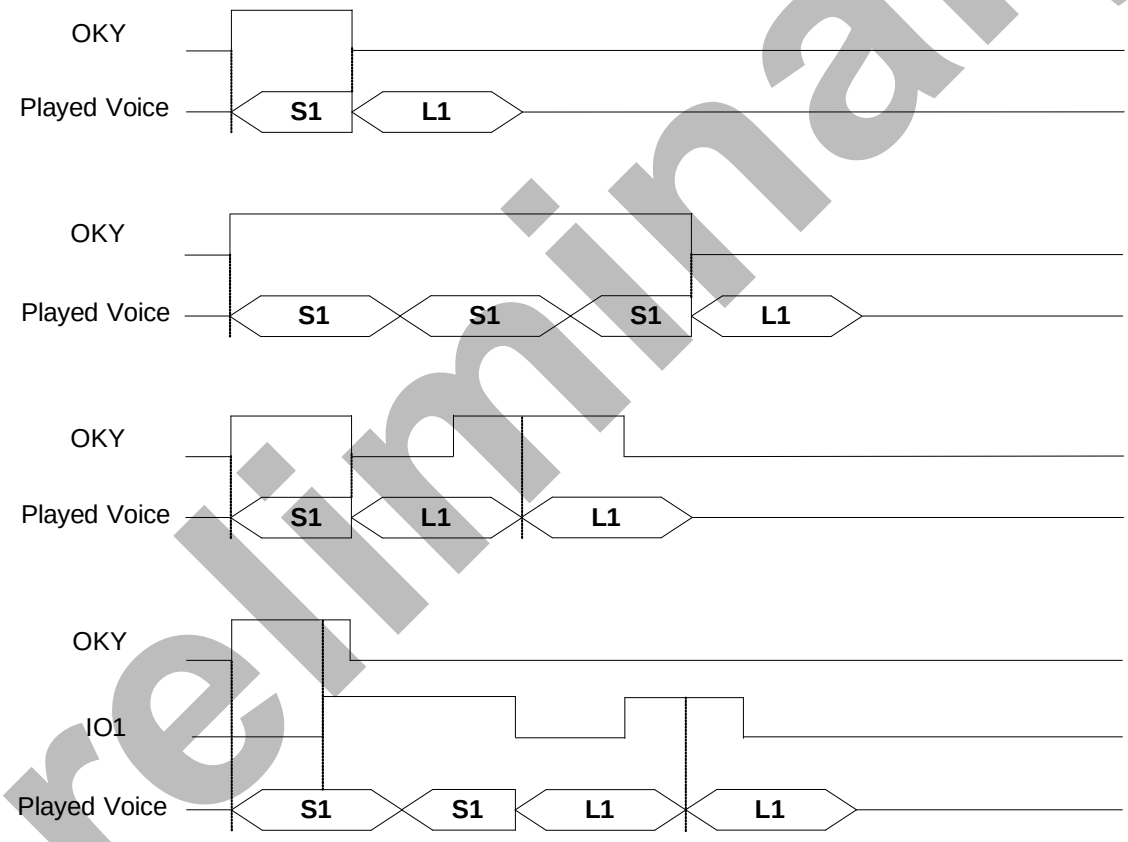
(b) OKY (E/U/R) =S1 L1 S2 S3, IO1 (x/U/x) = S32 L1, IO2 (x/x/x) = S31





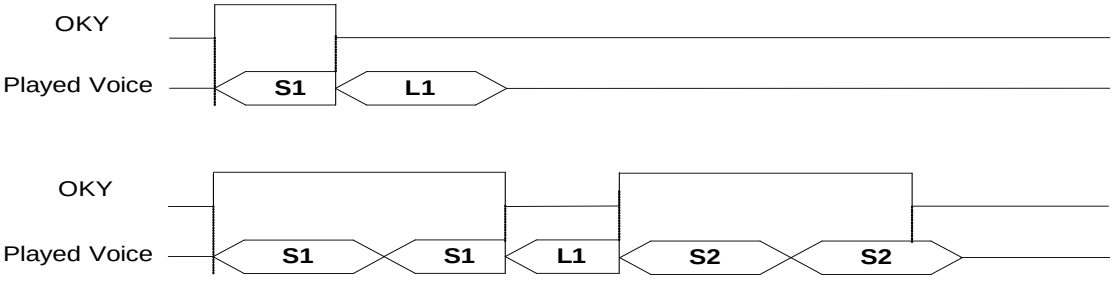
※ While playing OKY's Looping voice (L1, key is released), to trigger OKY or IO1 is active at Retrigger mode.

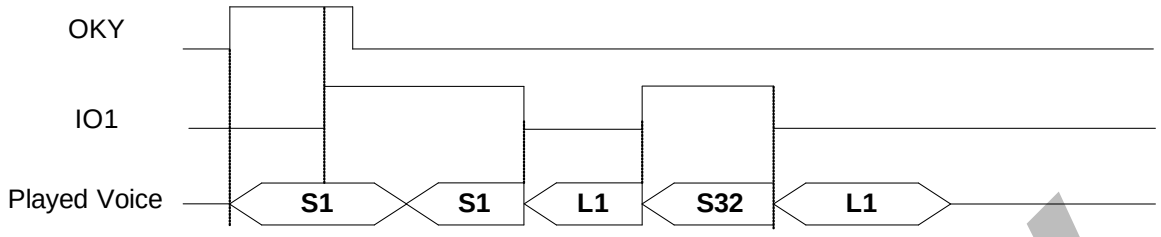
(c) OKY (L/U/I) =S1 L1 S2 S3, IO1 (L/U/I) = S32 L1, IO2 (L/U/I) = S31



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

(d) OKY (L/U/R) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L1, IO2 (x/x/x) = S31

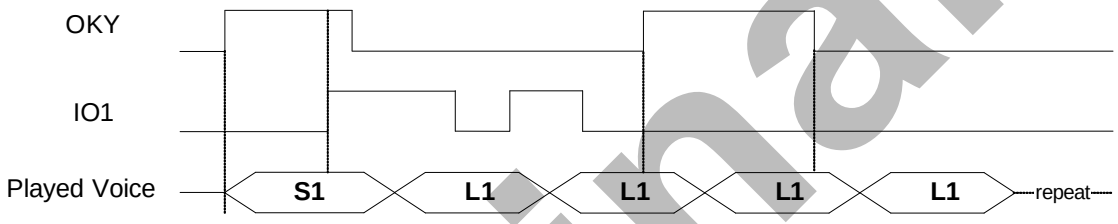




※ While playing OKY's Looping voice (L1, key is released), to trigger OKY or IO1 is active at Retrigger mode.

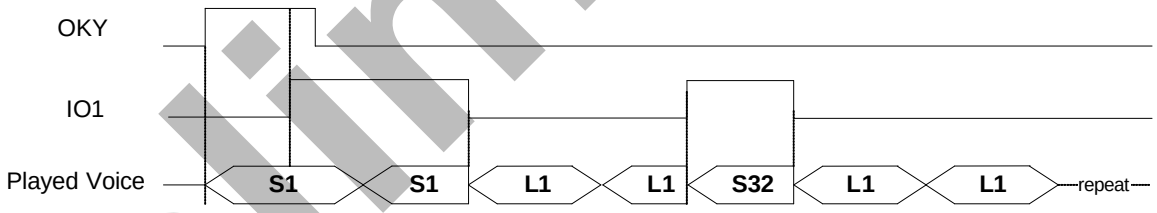
2) KeyReleaseJump with Jumping and Looping

(a) OKY (E/U/I) =S1 L1 S2 S3, IO1 (x/x/x) = S32 L1, IO2 (x/x/x) = S31



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

(b) OKY (L/U/R) =S1 L1 S2 S3, IO1 (x/U/x) = S32 L1, IO2 (x/x/x) = S31



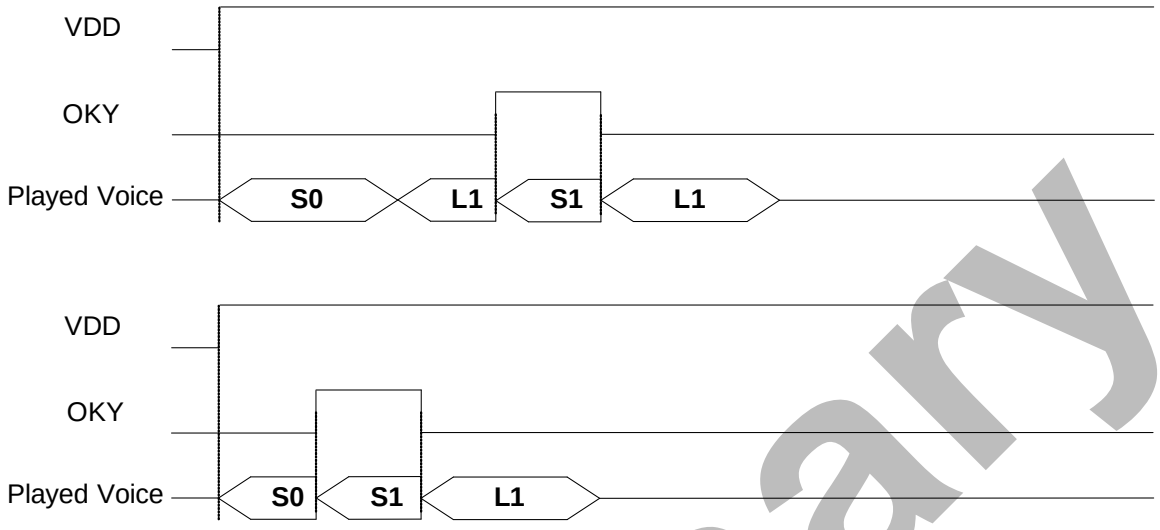
※ While playing OKY's Looping voice (L1, key is released), to trigger OKY or IO1 is active at Retrigger mode.

3) PowerOnPlay with KeyReleaseJump

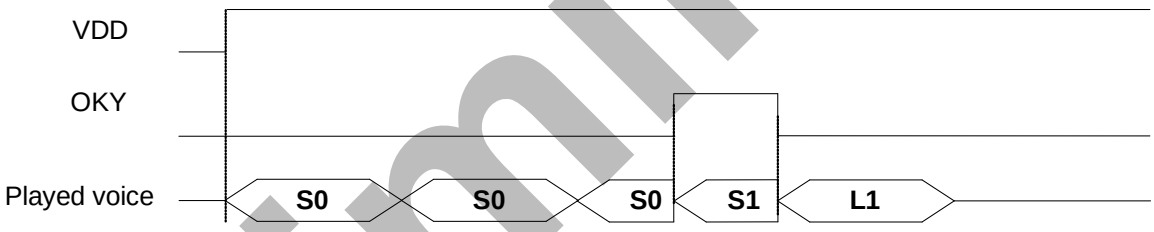
The trigger mode of PowerOnPlay is either as E/U/R or E/U/I. When the trigger mode is E/U/R, other trigger signal will stop PowerOnPlay's voice immediately and play the interrupted trigger's voice no matter what condition is Reload or Jumping. On the contrary, the any trigger is not active during PowerOnPlay's voice when the trigger mode of PowerOnPlay is E/U/I

PowerOnPlay (E/U/R) =S0 L1, OKY(L/U/I) = S1 L1 S2 S3,

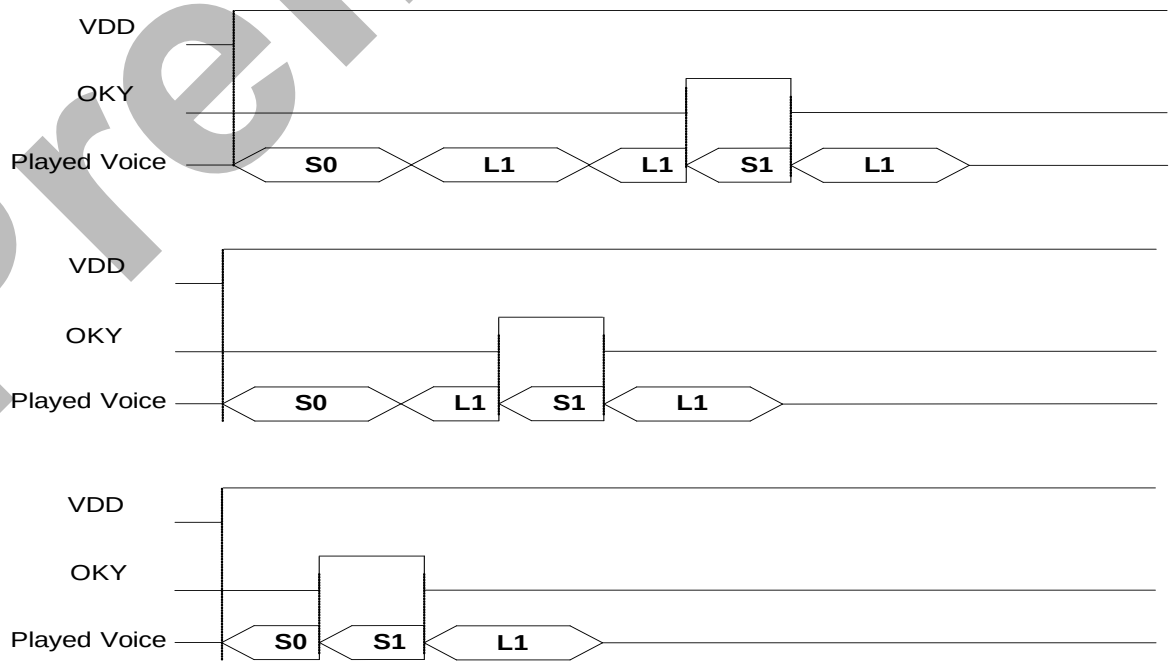
(a) S0 and S1 are set Jump without Loop



(b) S0 is set Loop without Jump, S1 is set Jumping without Loop



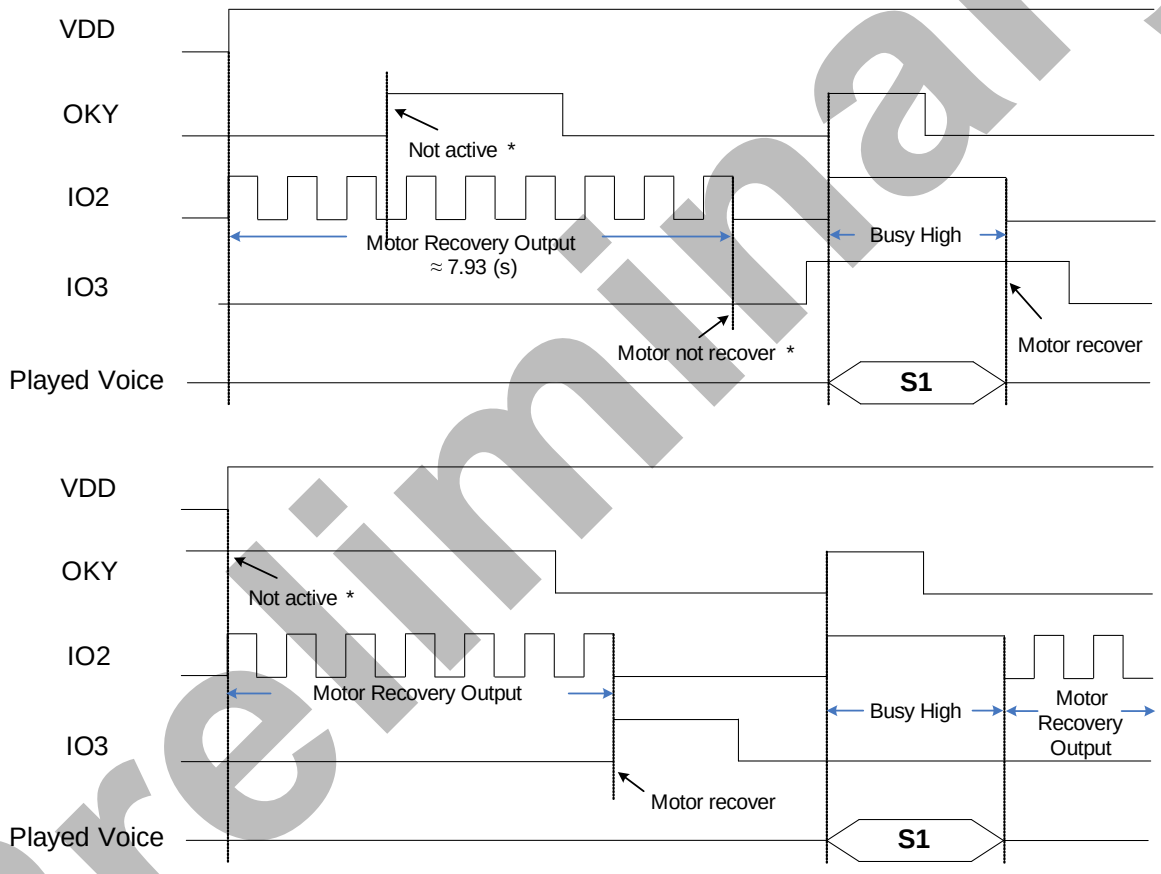
(c) S0 is set Jump with Loop, S1 is set Jump without Loop



8.8 Motor Recovery Function

When enable "Motor Recovery" function, IO2 is defaulted as an output pin which generates motor recovery output, IO3 is defaulted as an input pin which detects the motor comes back initial position or not. If the motor doesn't come back the initial position, IO2 generates motor recovery output (12Hz/DC). Conversely if the motor comes back the initial position or the time of motor recovery output exceed 7.93 second, IO2 stops generating motor recovery output (12Hz/DC). The motor recovery happened in following three conditions:

1) Power On



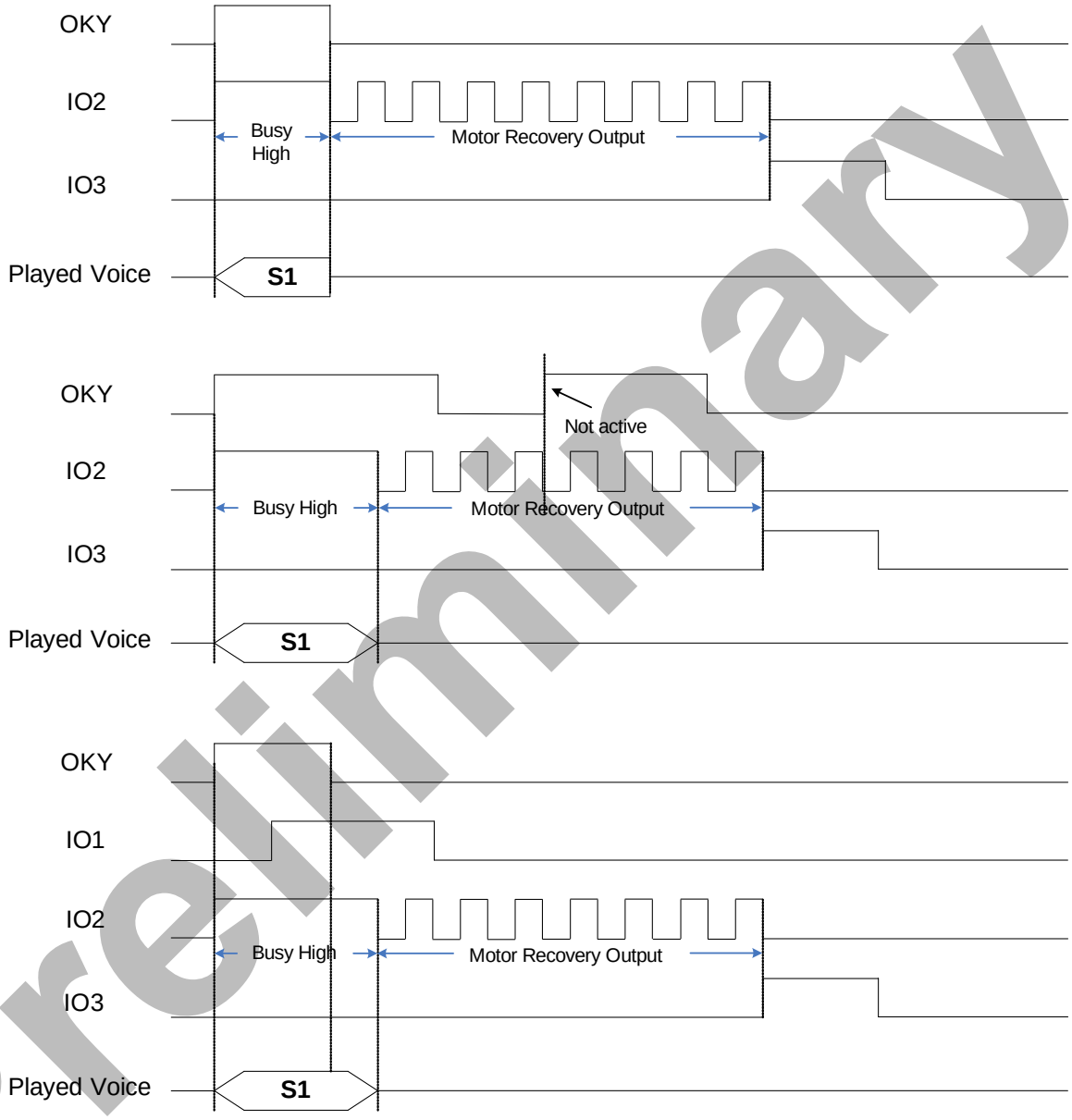
※ The any trigger is not active during motor recovery output.

※ Motor recovery output stop because time of motor recovery output exceed 7.93 second in first picture.

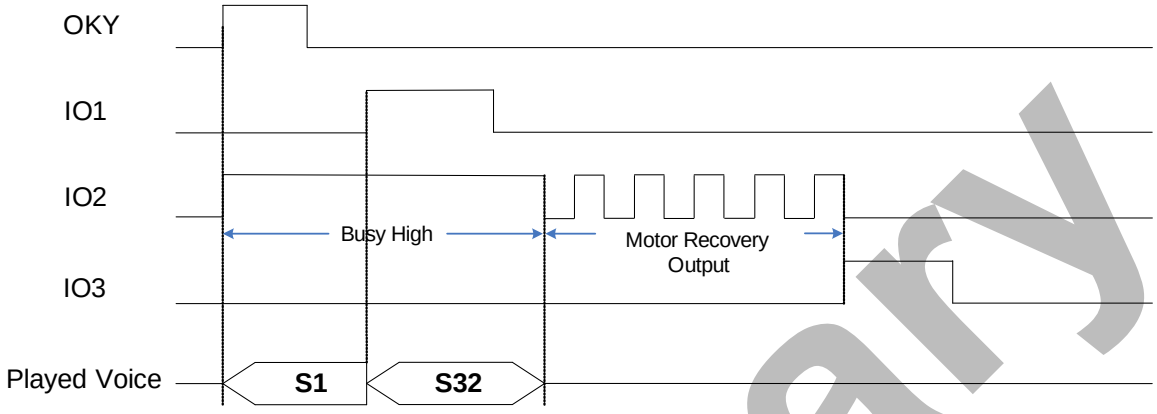
※ Motor recovery output stop because IO3 is high in second picture.

2) Terminal Voice

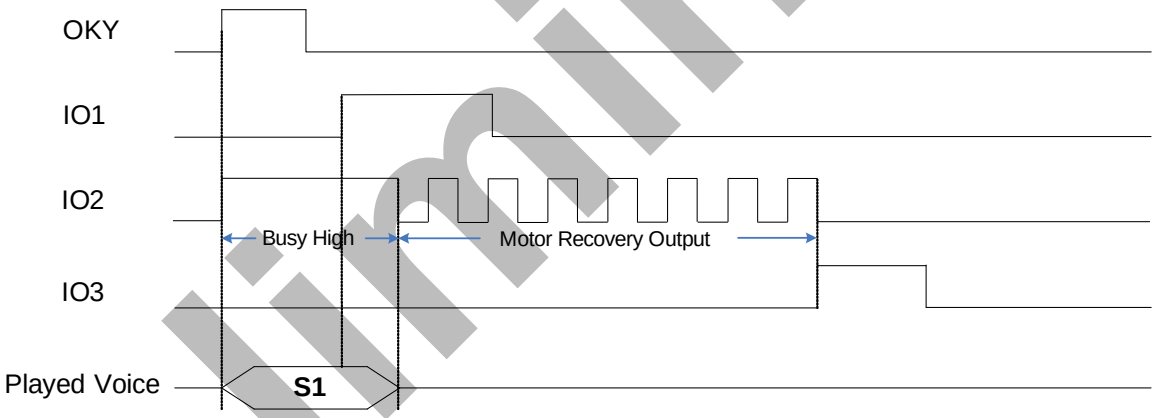
(a) OKY (E/H/X) =S1 S2 S3, IO1 (E/x/x) = S32, IO2 = Normal / Motor Recover Output (Busy High / 12Hz).



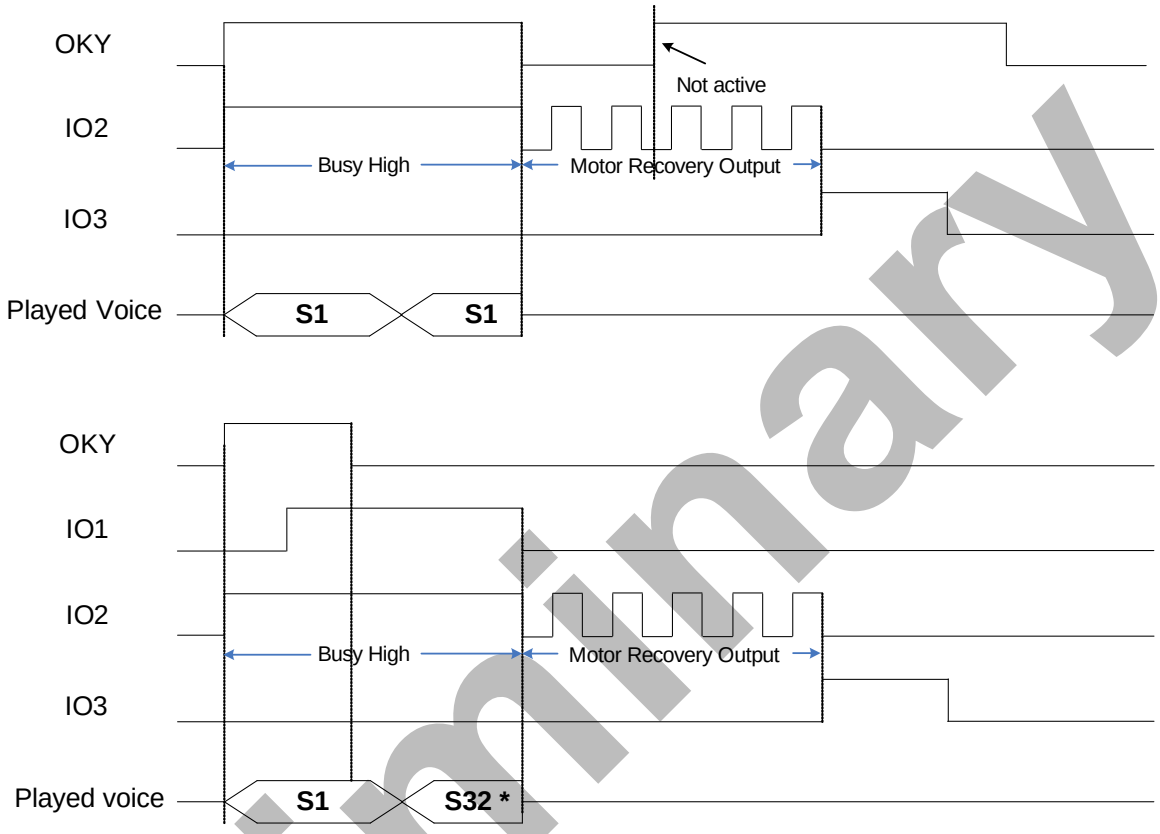
(b) OKY (E/U/R) =S1 S2 S3, IO1 (E/U/x) = S32, IO2 = Normal / Motor Recover Output (Busy High / 12Hz).



(c) OKY (E/U/I) =S1 S2 S3, IO1 (x/x/x) = S32, IO2 = Normal / Motor Recover Output (Busy High / 12Hz).

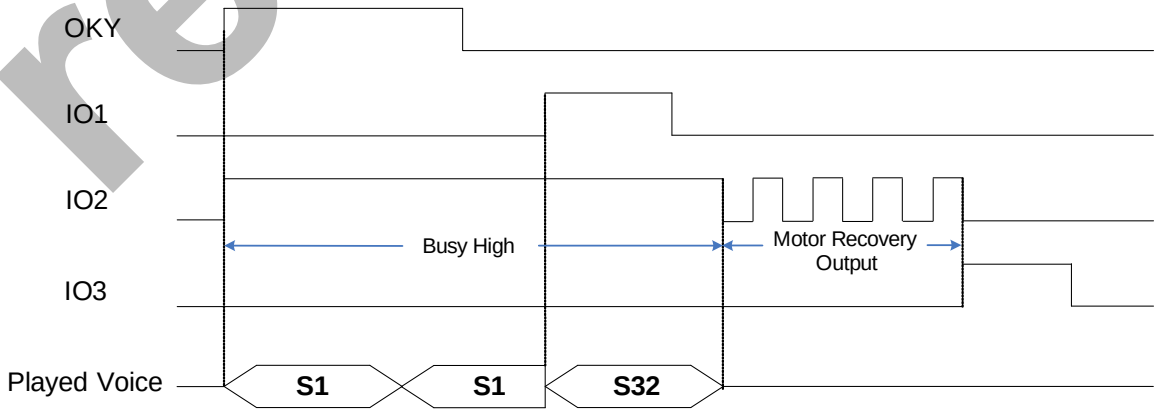


(d) OKY (L/H/X) =S1 S2 S3, IO1 (L/H/x) = S32, IO2 = Normal / Motor Recover Output (Busy High / 12Hz).

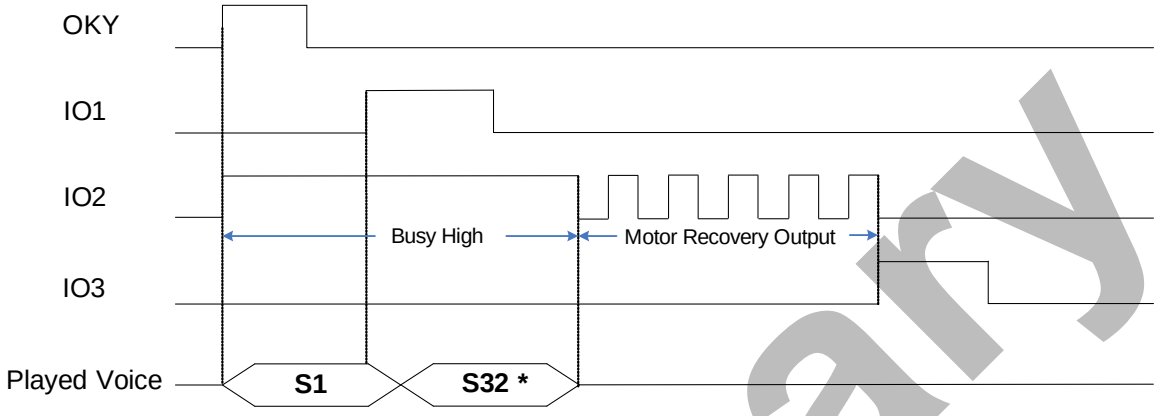


※ If S1 enable "Jump" or "Loop" function, the second subtable changes from S32 to S1

(e) OKY (L/U/R) =S1 S2 S3, IO1 (L/U/x) = S32, IO2 = Normal / Motor Recover Output (Busy High / 12Hz).

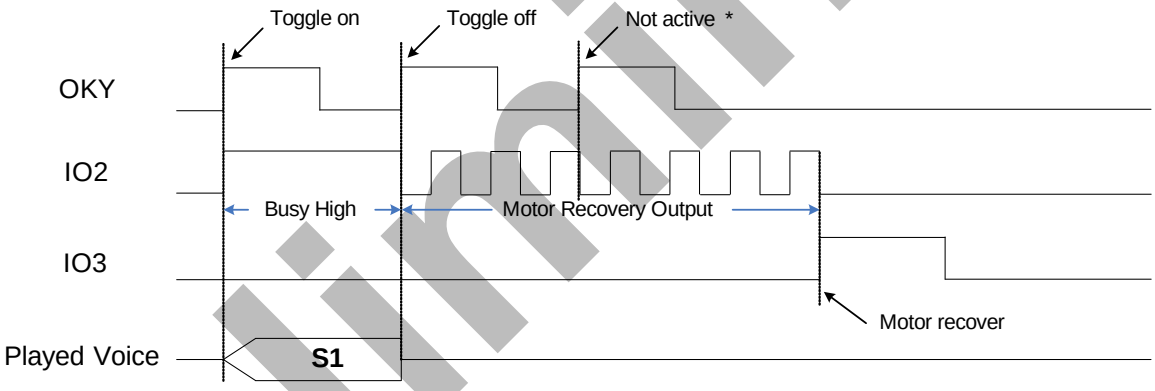


(f) OKY (L/U/I) =S1 S2 S3, IO1 (L/U/x) = S32, IO2 = Normal / Motor Recover Output (Busy High / 12Hz).



※ If S1 enable "Jump" or "Loop" function, the second subtable changes from S32 to S1

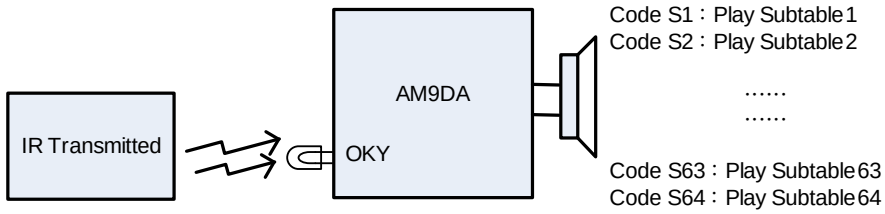
3) Toggle Off



※ The any trigger is not active during motor recovery output.

8.9 IR Received Function

In AM9DA Series, there provides an ”IR Received” function. This function uses OKY1 as receiving pin and user can used Alpha’s 4 bit MCU (Ex: AM4K、AM4G、AM5B…) is available to work as transmitting. After AM9DA Chip is received IR code, AM9DA will play the defined voice. See the following figure for its function:



When ”IR Received” is enabling, OKY pin defines IR Receiving as default. The property of this pin is fixed as short debounce and input floating (Edge / Unhold / Retrigger), thus, user can’t self-define OKY function.

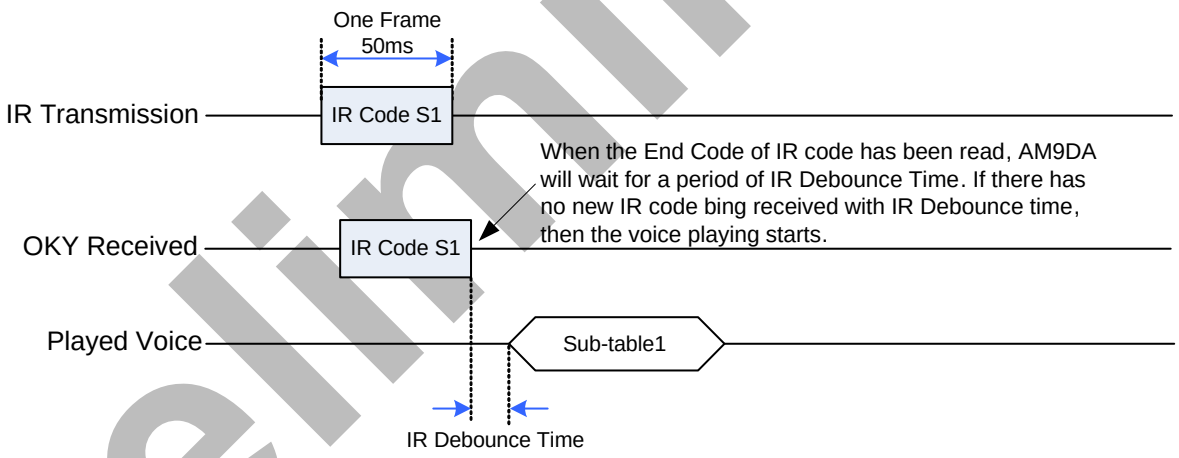
In IR Received function, AM9DA Series supports ”Single IR Code Transmitted” and ”Double IR Code Transmitted”, user can transmit either one IR code or two IR codes. When IR code has been received and judged as valid, then AM9DA plays the corresponding voice (sub-table); 64 sub-table voices are supported in maximum. In addition, to prevent IR signal from being disturbed that causes failed coding, ”IR Received” function provides two settings that are ”Short Debounce” and ”Long Debounce”. When choosing Short Debounce, set debounce time as 20ms while 60ms for Long Debounce.

The description of ”Single IR Code Transmitted” and ”Double IR Code Transmitted” are as follows:

1) Single IR Code Transmitted

Transmitter transmits IR code once. IC immediately plays the corresponding sub-table after received the single IR code. But the drawback of the method is that AM9DA receives false IR code because of noise, so that plays the false sub-table.

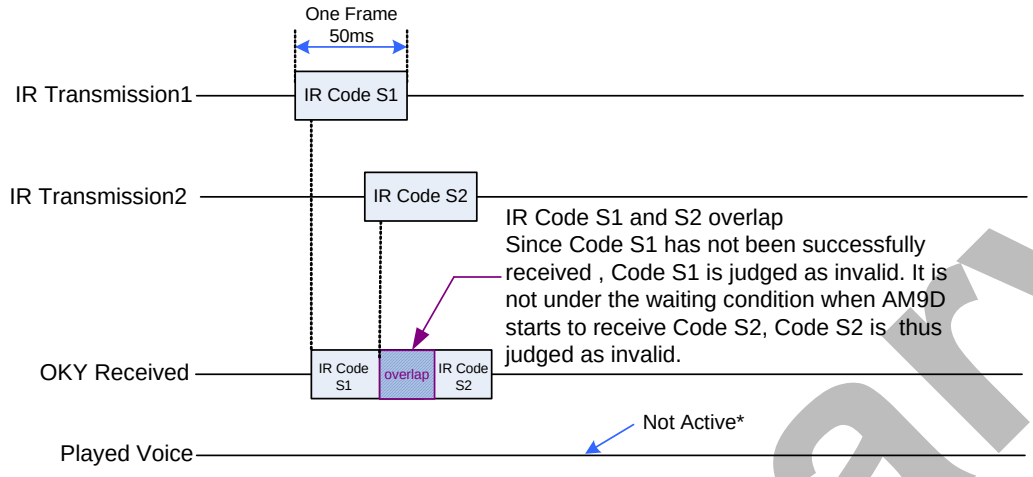
(a) IC only receive one IR code



※ AM9DA will delay IR debounce time after the IR code is completely transmitted; IC immediately plays the corresponding sub-table according to IR code.

※ IR debounce time (60mS / 20mS) depends on the “IR Debounce” option.

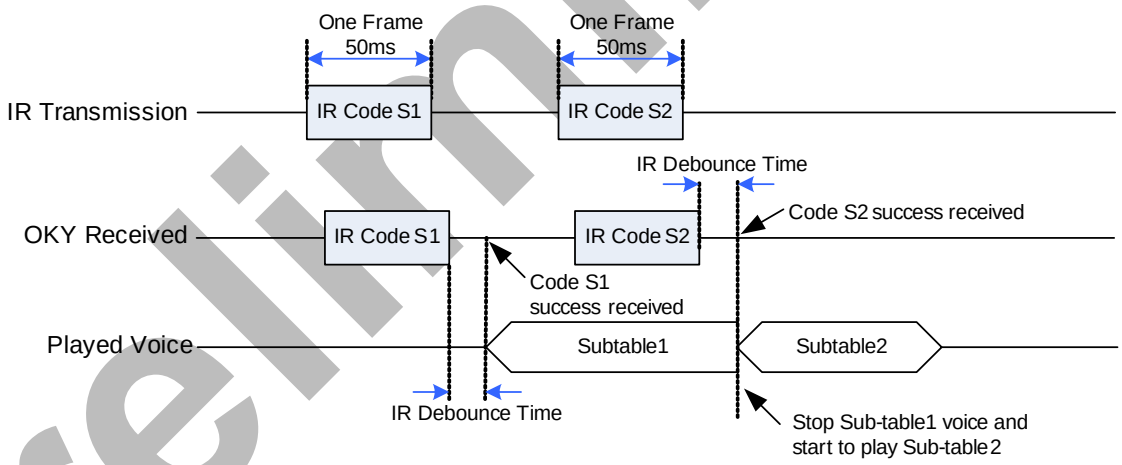
(b) IC simultaneously receive two IR codes



※ Because the overlapping IR codes result in receiving false data, the IR code is not active.

※ Even though the overlapping IR codes are identical, IR codes are regarded as false data.

(c) IC receive IR codes one after another



※ The key of transmitter is triggered when IC plays the sub-table of the first IR code.

※ The second trigger signal will stop voice of first IR code and play the interrupted voice of second IR code

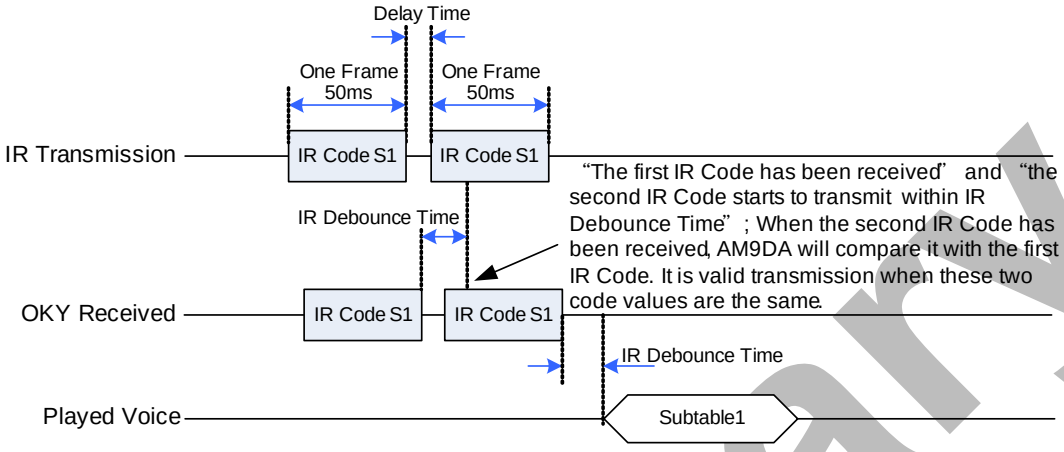
2) Double IR Code Transmitted

The IR codes are prone to affect by noise in above-mentioned method. In following method, the transmitter transmits the same IR codes twice at a time, and receiver compares the two IR codes.

If the two IR codes are different, then they are regarded as false data; therefore, the trigger is not active.

The advantage of using the method of Double IR Codes Transmitted is to avoid from being disturbed by noise that may cause failed trigger; yet the disadvantage on the other hand is that it plays the corresponding voice after two IR codes have been transmitted and are judged as correct. There is approximately 0.1S~0.2S delay time from transmitting IR codes to play voice by AM9DA IC.

(a) IC receive the same IR codes

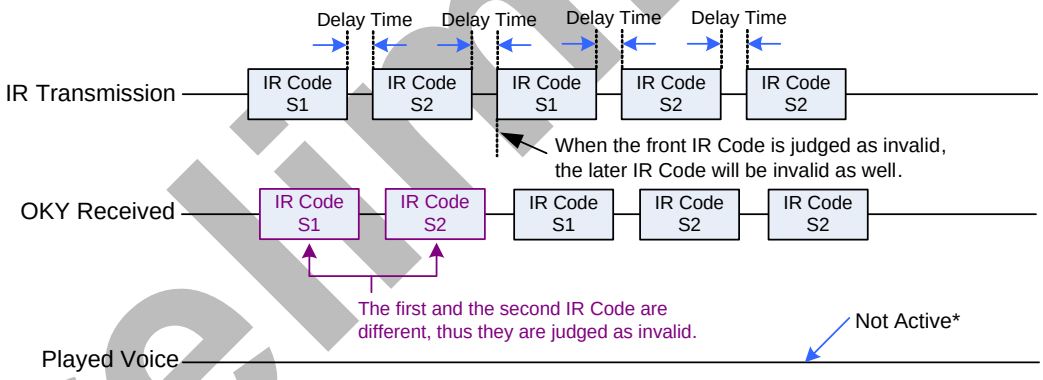


※ The same IR codes are transmitted twice at a time, after the key of transmitter is triggered.

※ The interval between the first and the second IR code delay time is 10mS ~ IR debounce time.

※ IC plays the corresponding sub-table according to IR code after two IR codes are compared correctly.

(b) IC receive the different IR codes



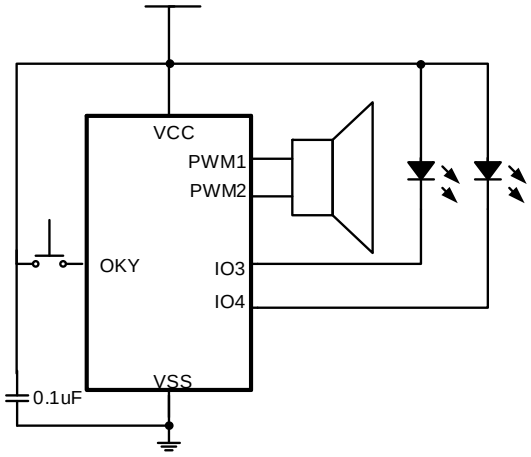
※ Because the second received IR codes is different from the first IR code, the trigger is not active.

※ When received IR codes are judged invalid, AM9DA considers it as failed transmission. If user keeps transmitting IR codes within IR debounce time (20ms/60ms), it remains invalid regardless of whether there are two same IR codes.

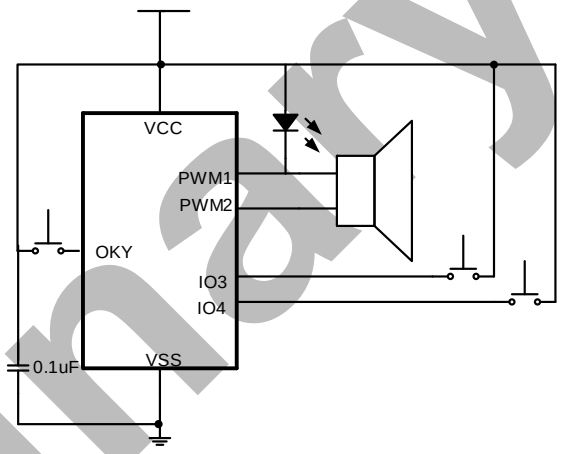
9 Application Circuit

(1) 1 trigger, 2 LEDs.

OKY is input while IO3 and IO4 are output.

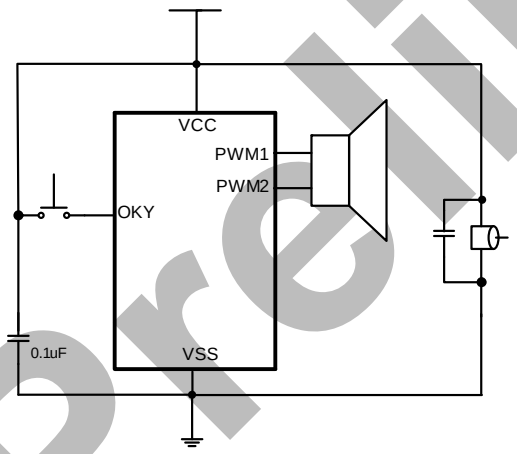


(2) 3 triggers, 1 LED.



(3) 1 triggers, 1 motor.

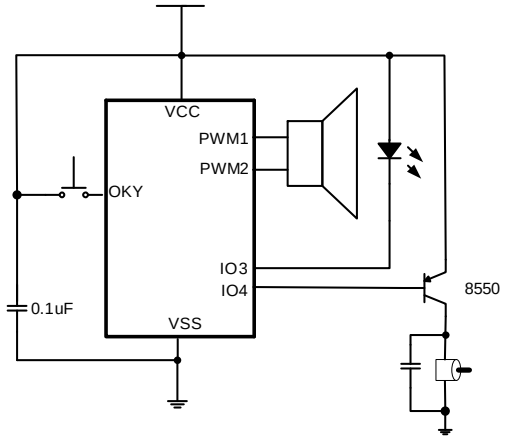
OKY is input.



* When driving the motor, it is recommended to place one capacitor between V_{CC} and V_{SS}.

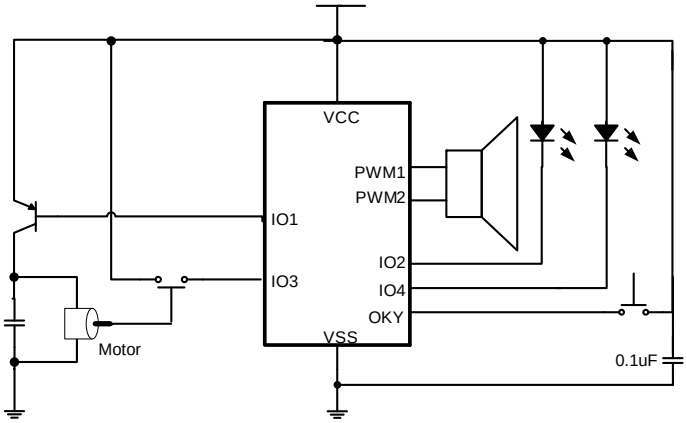
(4) 1 trigger, 1 LED, 1 motor.

IO3 and IO4 are output.

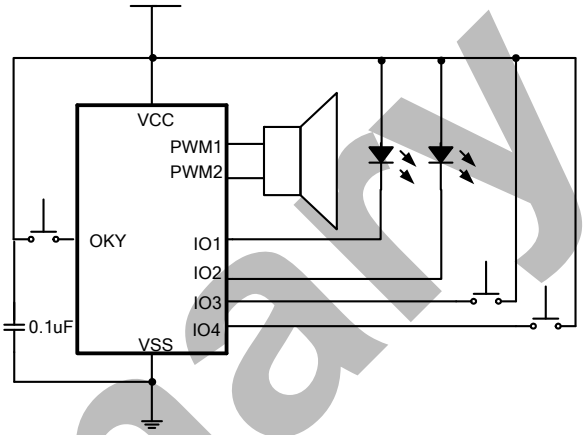


* Set IO3 and IO4 as output mode, and select “Sync output” for driving the motor.
* When driving the motor, it is recommended to place one capacitor between V_{CC} and V_{SS}.

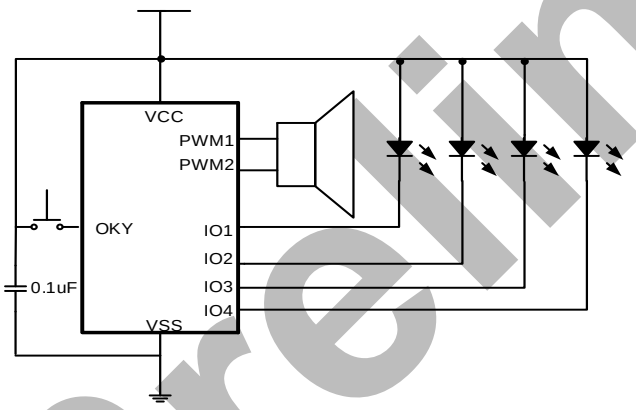
(5) OKY is input, IO1 is output, IO3 is input.



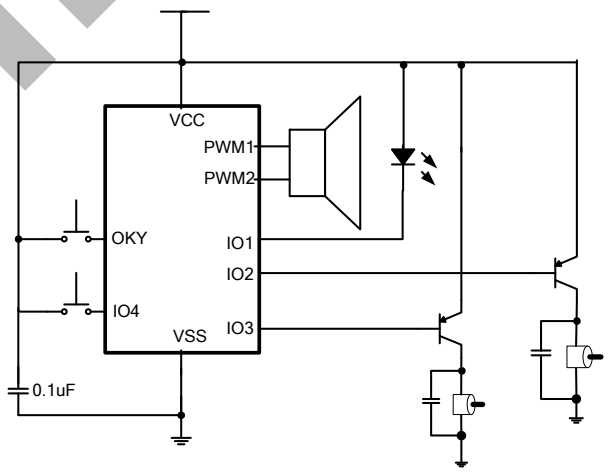
(6) 3 triggers, 2 LED, external oscillator.



(7) 1 input, 4 LEDs, internal oscillator.
IO1 / IO2 / IO3 / IO4 are output.



(8) 2 triggers, 1 LED, 2 motors, external oscillator.
IO1 / IO2 / IO3 are output.



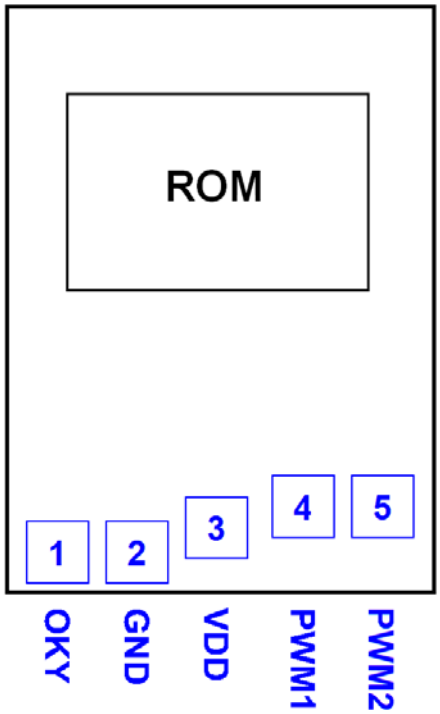
* Set IO1 / IO2 / IO3 as output mode, and select “Sync output” for driving 2 motors and 1 LED.

* When driving motors, it is recommended to place one capacitor between V_{CC} and V_{SS}.

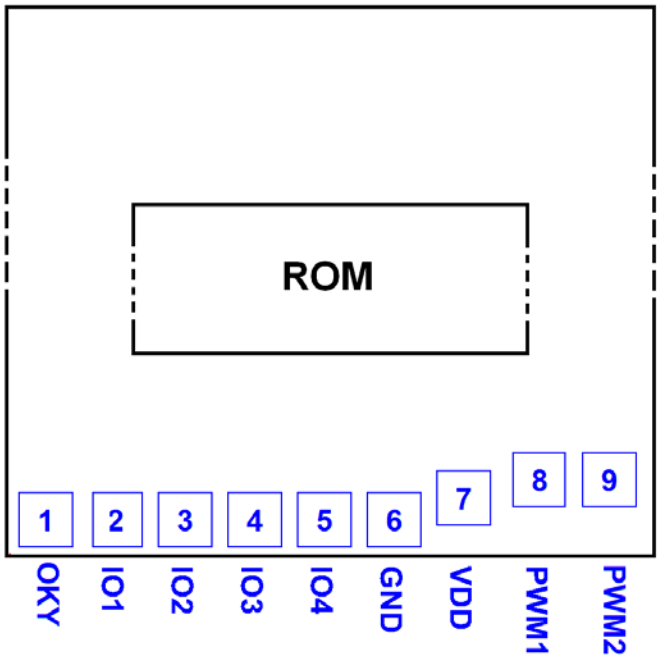
Note: The above application circuits are for reference only. For further information, please contact Alpha.

10 Bonding Diagram

10.1 AM9DA014x



10.2 AM9DA130x/AM9DA065x/AM9DA035x



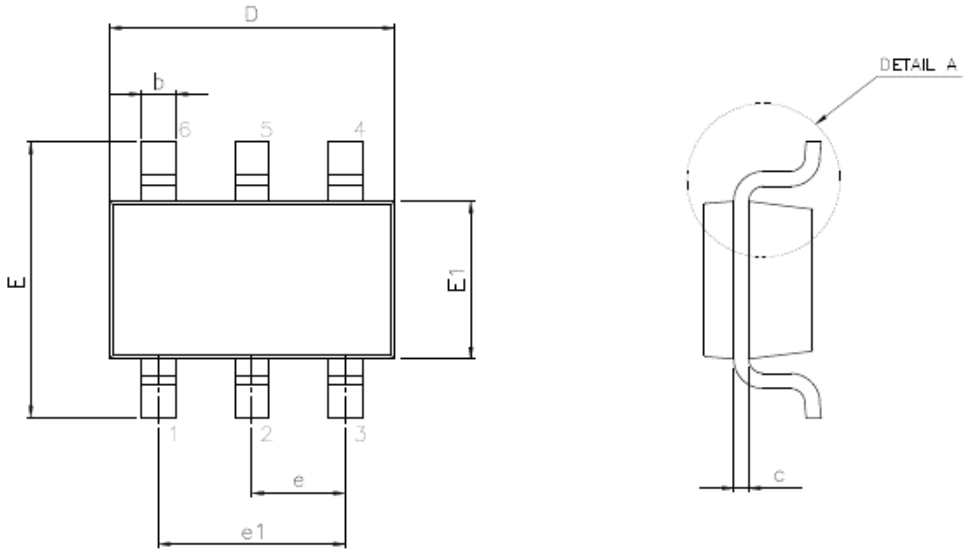
Note: The IC substrate must be connected to VSS.

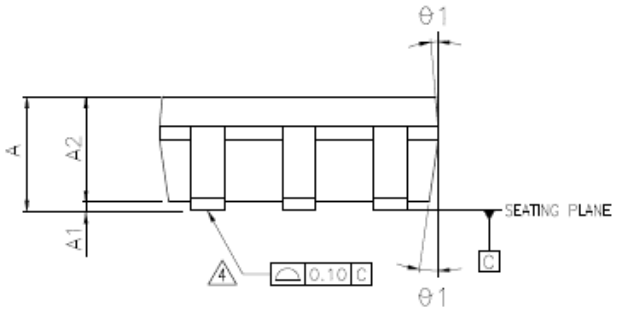
11 Package Dimension

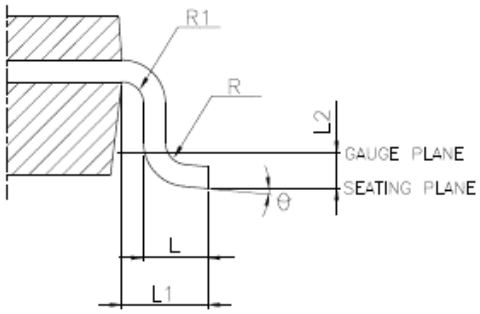
Package Type	Package Body Size (mm)
SOT23-6	2.9 x 1.6 x 1.15
SOP8L	4.9 x 3.9 x 1.4
PDIP8L	9.25 x 6.35 x 1.4
SOP14L	8.65 x 3.9 x 1.4
PDIP14L	19.1 x 6.35 x 3.3

11.1 SOT23-6

VARIATIONS (ALL DIMENSIONS SHOWN IN MM)							
SYMBOLS	**MIN.**	**NOM.**	**MAX.**	**SYMBOLS**	**MIN.**	**NOM.**	**MAX.**
A	—	—	1.45	**e1**	1.90 BSC.		
A1	0.00	—	0.15	**L**	0.30	0.45	0.60
A2	0.90	1.15	1.30	**L1**	0.60 REF.		
b	0.30	—	0.50	**L2**	0.25 BSC.		
c	0.08	—	0.22	**R**	0.10	—	—
D	2.90 BSC.			**R1**	0.10	—	0.25
E	2.80 BSC.			θ	0°	4°	8°
E1	1.60 BSC.			θ1	5°	10°	15°
e	0.95 BSC.			—	—	—	—



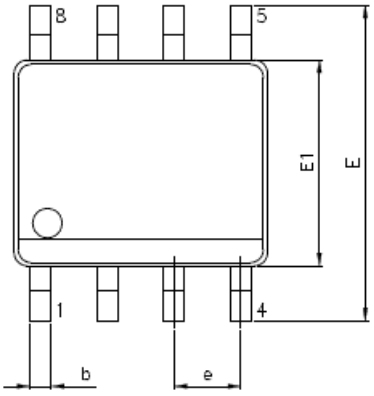


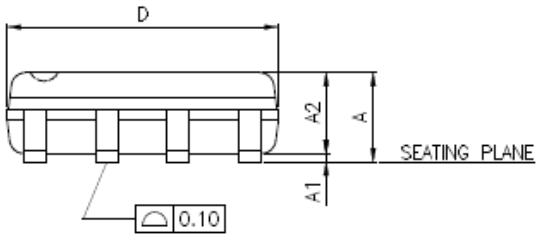


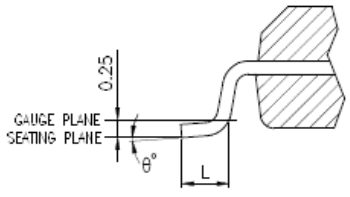
DETAIL A

11.2 SOP8L

VARIATIONS (ALL DIMENSIONS SHOWN IN MM)					
SYMBOLS	**MIN.**	**MAX.**	**SYMBOLS**	**MIN.**	**MAX.**
A	—	1.75	**E**	6.00 BSC	
A1	0.10	0.25	**E1**	3.90 BSC	
A2	1.25	—	**e**	1.27 BSC	
b	0.31	0.51	**L**	0.40	1.27
c	0.10	0.25	**h**	0.25	0.50
D	4.90 BSC		θ°	0	8

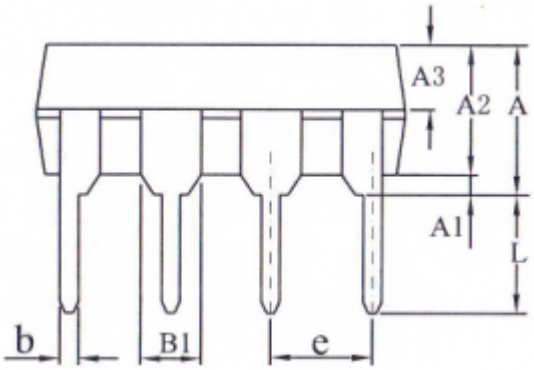


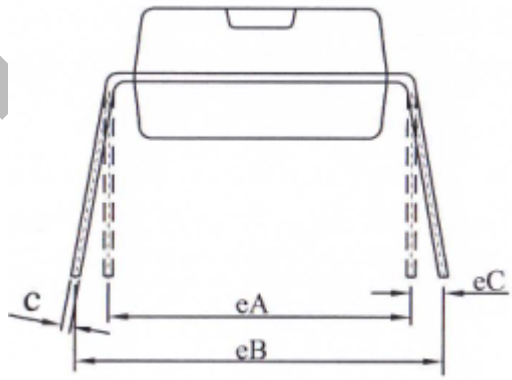


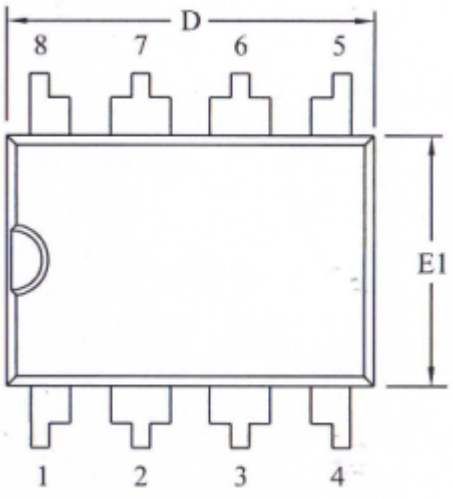


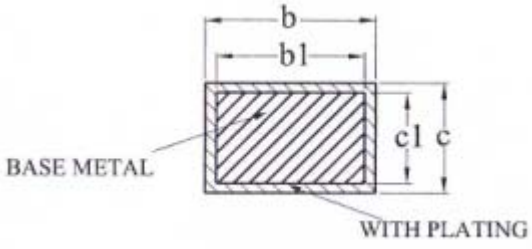
11.3 PDIP8L

VARIATIONS (ALL DIMENSIONS SHOWN IN MM)							
SYMBOLS	**MIN.**	**NOM.**	**MAX.**	**SYMBOLS**	**MIN.**	**NOM.**	**MAX.**
A	3.60	3.80	4.00	**c1**	0.24	0.25	0.26
A1	0.51	—	—	**D**	9.15	9.25	9.35
A2	3.20	3.30	3.40	**E1**	6.25	6.35	6.45
A3	1.55	1.60	1.65	**e**	2.54BSC		
b	0.44	—	0.52	**eA**	7.62REF		
b1	0.43	0.46	0.49	**eB**	7.62	—	9.30
B1	1.52REF			**eC**	0	—	0.84
c	0.25	—	0.29	**L**	3.00	—	—



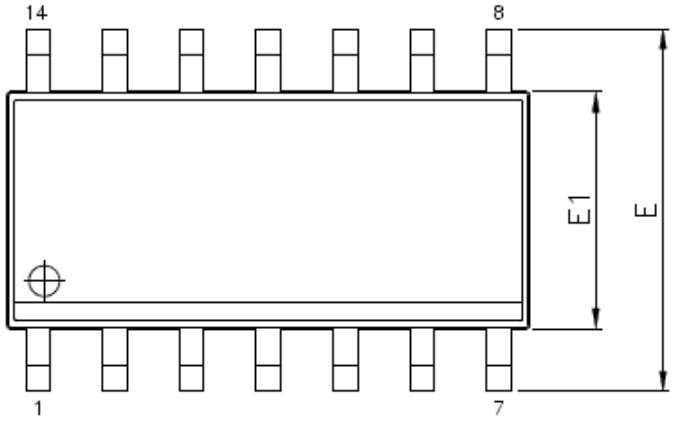


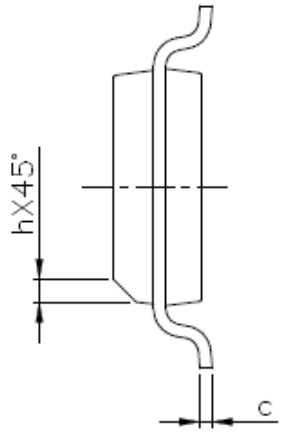


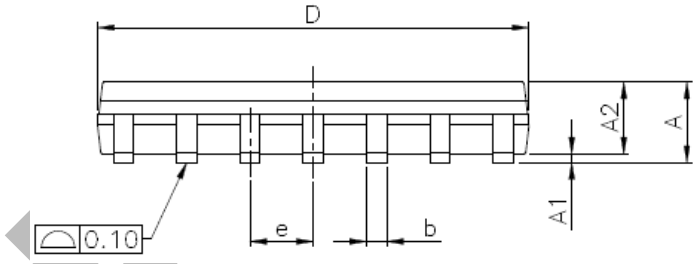


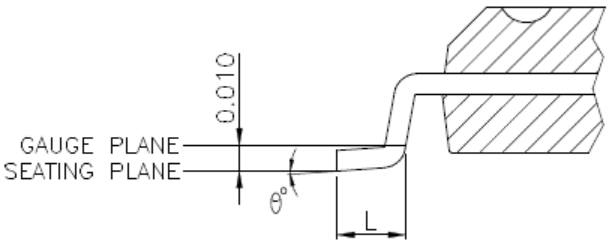
11.4 SOP14L

VARIATIONS (ALL DIMENSIONS SHOWN IN MM)							
SYMBOLS	**MIN.**	**NOM.**	**MAX.**	**SYMBOLS**	**MIN.**	**NOM.**	**MAX.**
A	—	—	1.75	**E**	5.80	6.00	6.20
A1	0.05	—	0.225	**E1**	3.80	3.90	4.00
A2	1.30	1.40	1.50	**e**	1.27 BSC.		
b	0.39	—	0.47	**L**	0.50	—	0.80
C	0.20	—	0.24	θ°	0	—	8
D	8.55	8.65	8.75	—	—	—	—



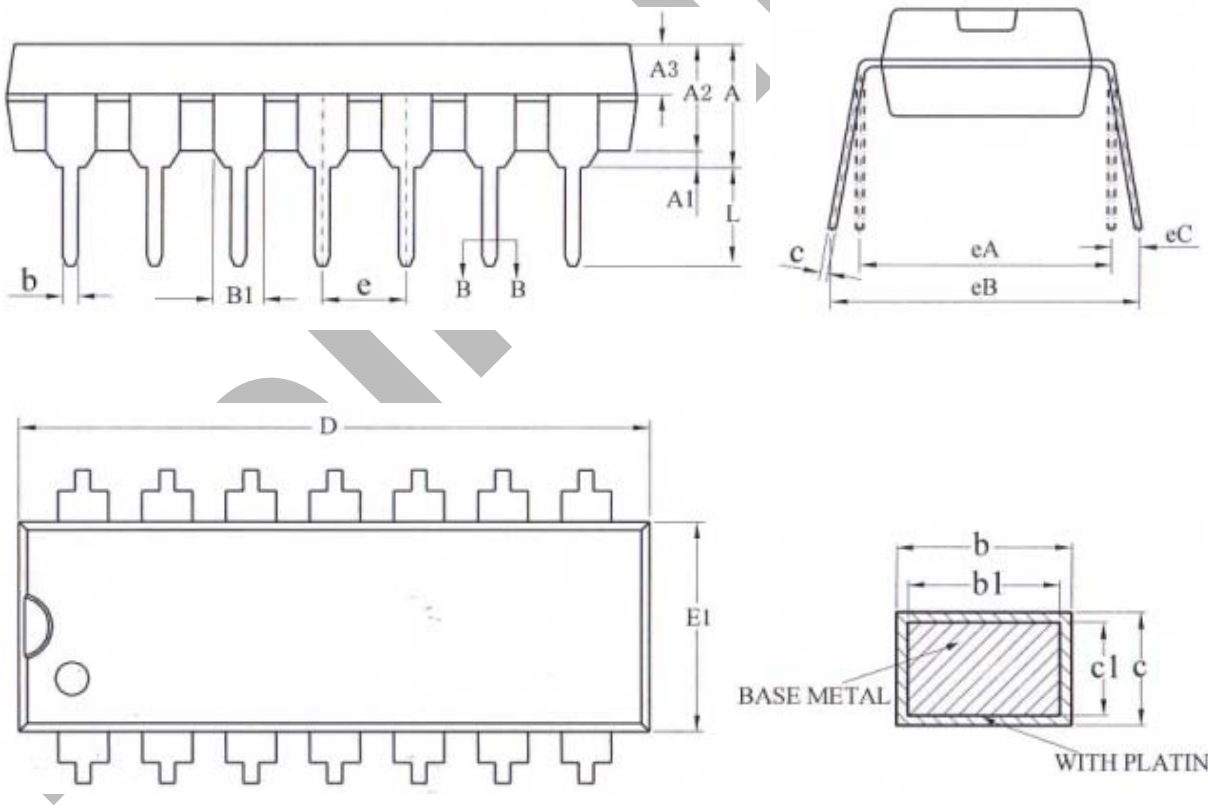






11.5 PDIP14L

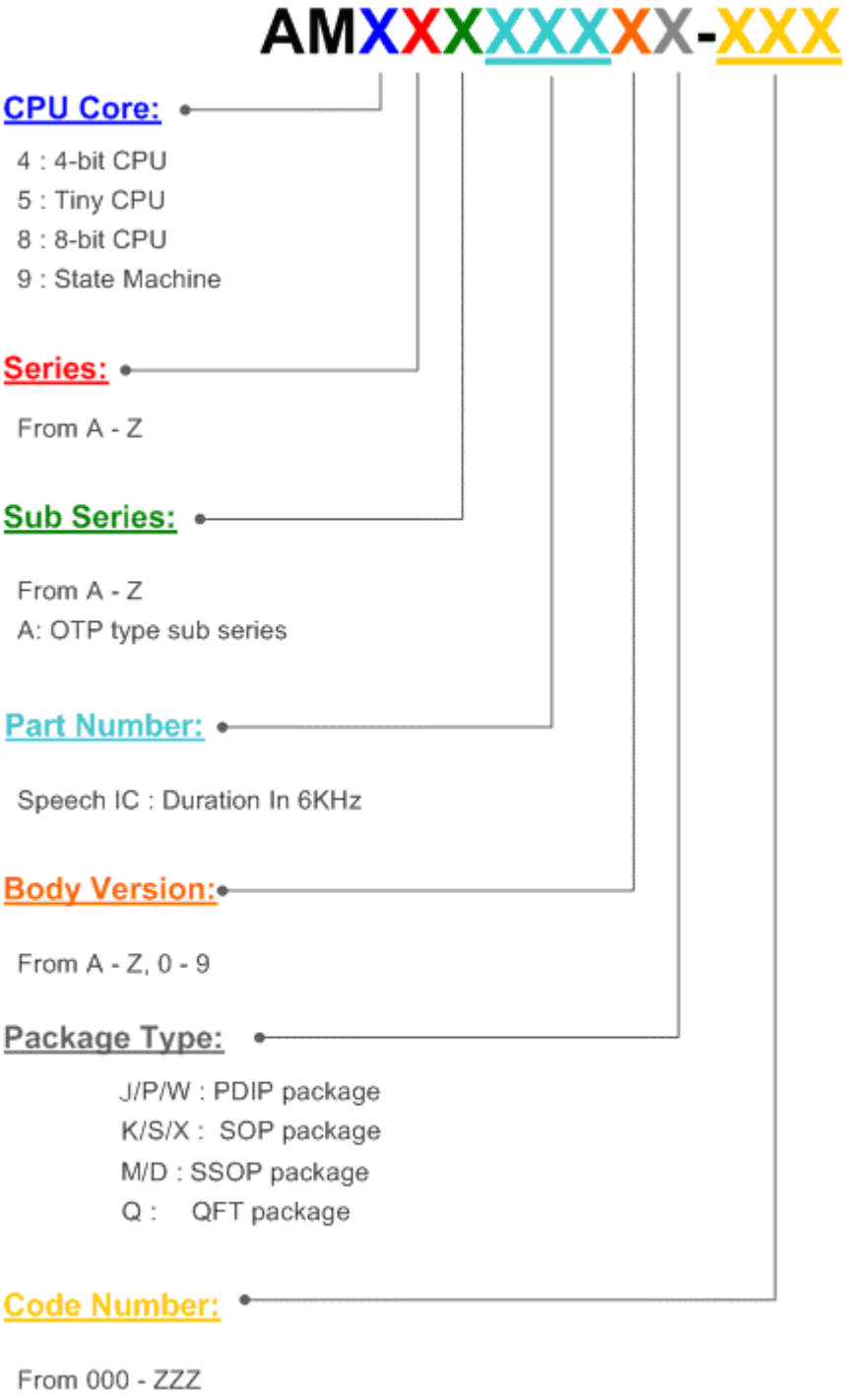
VARIATIONS (ALL DIMENSIONS SHOWN IN MM)							
SYMBOLS	**MIN.**	**NOM.**	**MAX.**	**SYMBOLS**	**MIN.**	**NOM.**	**MAX.**
A	3.60	3.80	4.00	**c1**	0.24	0.25	0.26
A1	0.51	—	—	**D**	19.00	19.10	19.20
A2	3.20	3.30	3.40	**E1**	6.25	6.35	6.45
A3	1.47	1.52	1.57	**e**	2.54 BSC		
b	0.44	—	0.52	**eA**	7.62REF		
b1	0.43	0.46	0.49	**eB**	7.62	—	9.30
B1	1.52REF			**eC**	0	—	0.84
c	0.25	—	0.29	**L**	3.00	—	—



12 Ordering Information

P/N *	Package Type	Pin Count	Package Size
AM9DA014A	Die	5	—
AM9DA014	SOT	6	63 mil
AM9DA035A	Die	9	—
AM9DA035AX	SOP	8	150 mil
AM9DA035AW	PDIP	8	300 mil
AM9DA035AS	SOP	14	150 mil
AM9DA035AP	PDIP	14	300 mil
AM9DA065A	Die	9	—
AM9DA065AX	SOP	8	150 mil
AM9DA065AW	PDIP	8	300 mil
AM9DA065AS	SOP	14	150 mil
AM9DA065AP	PDIP	14	300 mil
AM9DA130A	Die	9	—
AM9DA130AX	SOP	8	150 mil
AM9DA130AW	PDIP	8	300 mil
AM9DA130AS	SOP	14	150 mil
AM9DA130AP	PDIP	14	300 mil

*** Indication of Part Number (P/N):**



13 Appendix1 AM9DA Series Function List

Function \ Body		AM9DA130x	AM9DA065x	AM9DA035x	AM9DA014x
Input Mode	OKY1/IO5	V	V	V	V
	IO1	V	V	V	—
	IO2	V	V	V	—
	IO3	V	V	V	—
	OKY2/IO4	V	V	V	—
Output Mode	Busy-High Active	V	V	V	V
	Busy-Low Active	V	V	V	V
	12Hz Flash	V	V	V	V
	6Hz Flash	V	V	V	V
	3Hz Flash	V	V	V	V
	PIO	V	V	V	—
	1/2 Dynamic	V	V	V	—
Play Speed(Hz)		4K, 4.132K, 4.310K, 4.425K, 4.630K, 4.808K, 5K, 5.208K, 5.556K, 5.747K, 6.024K, 6.329K, 6.757K, 7.143K, 7.576K, 8.065K, 8.621K, 9.259K, 10K, 10.870K, 12.195K, 13.514K, 15.152K, 17.241K, 20K, 23.810K, 25K			
Sub-table		64			16
Step		256			
Power On Play		V	V	V	V
POP Irretrigger		V	V	V	V
Toggle On/Off		V	V	V	V
Trigger (Random/Sequential)		V	V	V	—
Jumping		V	V	V	V
Looping		V	V	V	V
Key Release Jump		V	V	V	V
Reset		V	V	V	—
Try Me Mode		V	V	V	—
Anti-Noise		V	V	V	—
Motor Recover		V	V	V	—
IR Received		V	—	—	—

14 Appendix2 AM9DA Series Function Share Pin

I/O Name	Function Share Pin	I/O Mode
OKY1	VPP (Only OTP Series)	Input
	IR Received	Input
IO1	—	—
IO2	Motor Recover (Motor Output)	Output
IO3	Try Me Mode	Input
	Motor Recover (Sensor Input)	Input
OKY2/IO4	—	—