WTN3080
OTP voice musical chip with 3 In/Out ports

1. GENERAL DESCRIPTION

WTN3080 is single-chip voice synthesizing CMOS IC. It has embedded EPROM architecture, and OTP (One Time Programmable). There are maximum three I/O pins. Through accurate internal oscillation of +/- 0.5% tolerance, an external Rosc is unnecessary. There is only one PWM output for voice. Thus any external component is not required.

2. FEATURES

2.1. Wide operating voltage: 1.8V ~ 5.5V.

2.2. Three I/O pins: OKY1, IO1, IO2 can be either input or output pin.

2.3. The total voice duration can be partitioned up to maximum 768 *Voice Sections*. Each *Voice Section* length is flexible and each maximum or minimum *Voice Section* length is unlimited.

2.4. Total maximum 1536 *Voice Steps* are available for 128 *Voice Sentences*. OKY1, IO1, IO2 and POP can assign 64, 60, 1 and 1 *Sentences* independently. Each *Step* can specify one *Voice Section* and enable/disable IO1, IO2, OKY1 output option if IOx is set as output.

2.5. Only build in an accurate internal oscillator of +/- 0.5% tolerance, *no external R oscillator*. It can support different play speed option individually :

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
24.0kHz	20.0kHz	17.1kHz	15.0kHz	13.3kHz	12.0kHz	10.9kHz	10.0kHz	9.2kHz	8.6kHz
11	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
8.0kHz	7.5kHz	7.1kHz	6.7kHz	6.3kHz	6.0kHz	5.7kHz	5.5kHz	5.2kHz	5.0kHz
21	*22*	*23*	*24*	*25*	*26*	*27*	*28*		
4.8kHz	4.6kHz	4.4kHz	4.3kHz	4.1kHz	4.0kHz	3.9kHz	3.8kHz		

2.6. Input option for input pin:

2.6.1. Each input can select Edge/Level, Hold/Unhold and Retrigger/Irretrigger trigger modes.

2.6.2. Each input can select CDS+1.5M / CDS / 1.5M pull-low resistor or Floating type.

(CDS+1.5M option: Only 1.5M pull-low resistance at key-pressed, and 300K+1.5M in parallel pull-low resistance around 250K at key-released. CDS option: Floating at key-pressed, and 300K pull-low resistance at key-released.)

2.6.3. Each input can select Debounce time: Long debounce for push-button. Short debounce for fast switch.

2.6.7. OKY1 input can select One-Key Sequential or Random for maximum 64 & 60 *Sentences* independently. At One-Key Sequential, the Reset function of playing *Sentence* sequence can be selected or not when other keys are triggered.

2.6.8. Only one input pin can select Toggle On/Off function (1st Trigger -> play, 2nd trigger -> stop, ……).

※Note: Input priority is OKY1 >IO1 >IO2.

2.7. There are 4 kinds of output current option for all output pins.

2.7.1. Normal Sink Current output: Output is connected a LED with VDD. (I_{ol}=22mA/33mA @V_{DD}=3V/4.5V)

2.7.2. Large Sink Current output: Output is connected a LED with VDD. (I_{ol}=65mA/85mA @V_{DD}=3V/4.5V)

2.7.3. Constant Sink Current output: Output is connected a LED with VDD. Whenever VDD is 3V or 4.5V, the output current is constant and LED brightness is uniform. (I_{ol}=20mA/21mA @V_{DD}=3V/4.5V)

2.7.4. Drive Current output: Output is connected a LED with GND. (I_{oh}=7mA/11mA @V_{DD}=3V/4.5V)

2.8. There are 9 kinds of output option for all output pins:

2.8.1. Stop_Low pulse: Low active stop-pulse output whenever device stops playing.

2.8.2. Stop_High pulse: high active stop-pulse output whenever device stops playing.

(※Note: This option is not available for OKY1.)

2.8.3. Busy_High active: high active signal output during playing. (Drive output)

(※Note: This option is not available for OKY1.)

2.8.4. Busy_Low active: low active signal output during playing. (Sink output)

2.8.5. LED 3Hz flash: 3Hz sink signal output to drive LED during playing.

2.8.6. LED 6Hz flash: 6Hz sink signal output to drive LED during playing.

2.8.7. LED 12Hz flash: 12Hz sink signal output to drive LED during playing.

2.8.8. LED dynamic 1/2: according to 1/2 sound level, dynamic sink signal output to drive LED during playing.

2.8.9. QIO signal: arbitrary output with voice. For IO1, IO2, there are two sets of QIO signal. Each *Voice Step* can select one set of QIO signal. And for OKY1, there is no QIO signal to select.

※Note: Where 2.8.5. ~ 2.8.7 is the LED flash rate at 6kHz sample rate. For different play speed, the LED flash rate is different from original 1.4Hz, 3Hz, or 6Hz.

2.9. "*Mode-Switch*" special function: There is two kinds of functional modes that can be switched by IO1 input (Mode-Switch). For Mode-1 (IO1 -> GND) and Mode-2 (IO1 -> VDD), the output type of I/O setting is the same, but I/O function and voice/melody can be different.

2.10. "*Power-On-Play*" special function (POP): When power is on, play the POP Sentence one time. The trigger mode is fixed as Edge / Unhold / Retrigger. To cooperate with Power-On-Loop function, the POP Sentence will be played in loop until other key-trigger happened. When other key is triggered, it stops playing the POP Sentence and immediately plays the assigned sentence of triggered key.

2.11. "*2-Key Priority*" special function: Users can decide the priority of 2 different keys when both keys are pressed at the same time. There are two kinds of priority option: First Key and Last Key. For First Key, the prior pressed key is first priority to play voice, and it's normal operation. As for Last Key, the later pressed key is first priority to play voice, and it only supports OKY1 input pin. Users can use

Last Key option according to application requirement.

2.12. "*TG-Invert*" special function: When one *Voice Step* is optioned with Invert function, the trigger mode of Retrigger/Irretrigger will be inverted during playing that *Voice Section*. Users can insert Invert function in specific steps according to application requirement to change the trigger mode.

2.13. "*Table Random*" special function: When users need to play several sentences randomly and averagely, this function can be applied. At first trigger of OKY1, one random sentence will be played from OKY1 Sentences Table. After that, the played sentences for following OKY1 triggers will be sequential.

2.14. "*Pause-Resume*" special function: At playing OKY1 sentence, when key is triggered, the sentence playing will be paused, all LEDs are turned off and IC will enter sleep mode. At this moment, the standby current is very small about 0.05uA. To trigger OKY1 again, the sentence will resume and play sentence from the pause point.

※Note: Pause-Resume function cannot co-exist with Toggle On/Off function.

2.15. "*Anti-Noise Debounce*" special function: For a right trigger detection, the trigger signal needs a low-level Debounce time in advance of normal Debounce detection for high-level signal. It is used to prevent noise interference such like motor noise. With this function, the trigger signal won't result in double-trigger which usually occur when noise pull the high signal to low.

※Note: When enable this function, all inputs are optioned as Anti-Noise Debounce function.

2.16. Serial-Trigger function: In Edge/Unhold/Retrigger mode, by using the One-Key Sequential and Reset functions of OKY1 and setting the Debounce time to be short, IC can access external serial clock signal to playback the specific Sentence of OKY1. Usually it cooperates with an external MCU.

2.17. One 10-bit PWM output. There are 2 kinds of PWM output, normal and large. It can directly drive 8, 16, 32, 64Ω speaker or piezo-buzzer.

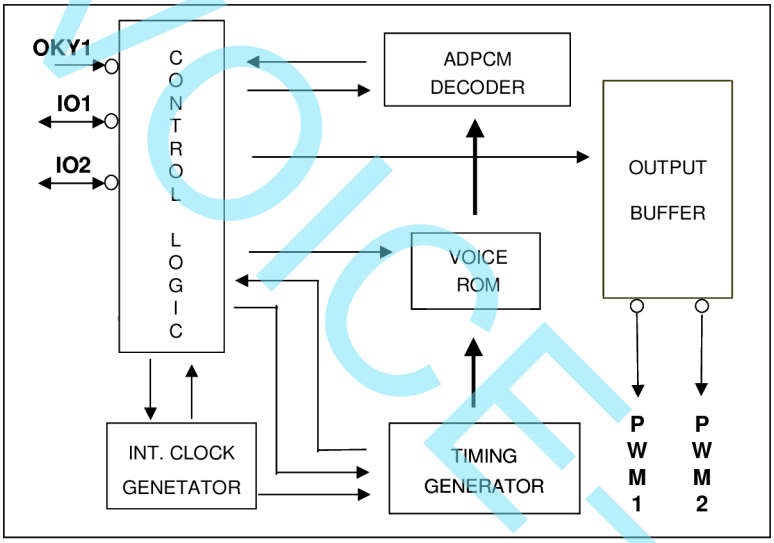
2.18. Low Voltage Reset (LVR=1.8V) is supported.

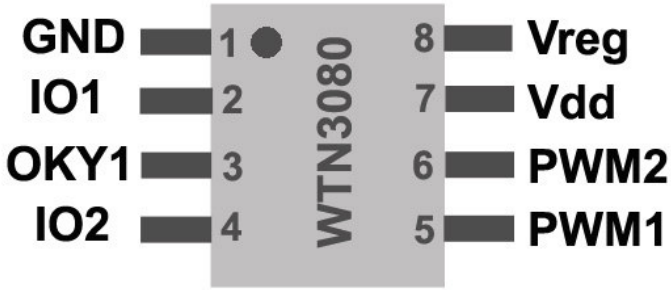
2.19. A unique fast writing mode is provided to speed up OTP writing time.

2.20. A special *ICP* (In Circuit Programming) writing function is supported for user to fabricate PCBA in advance.

2.21. Programmable code protection is provided. *(When the Security-Bit is burnt down, data can't be read.)*

3. BLOCK DIAGRAM





4. PAD DESCRIPTION

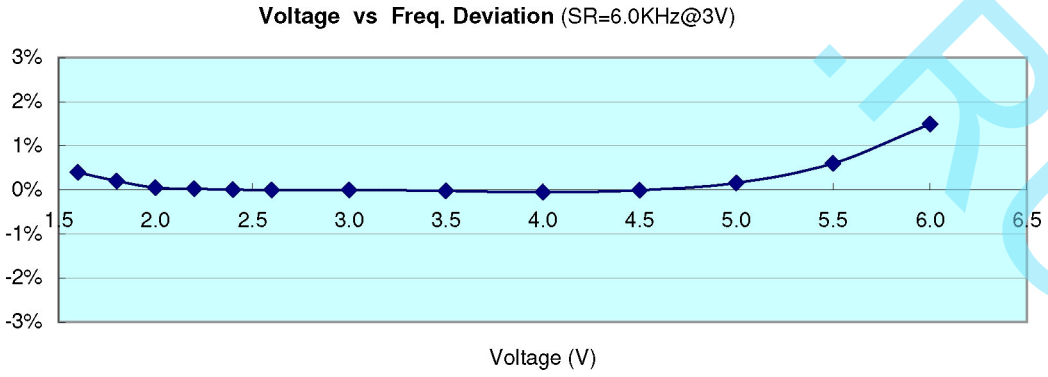
Pad Name	Pad No.	ATTR.	Description
GND	1	Power	Negative power.
IO1 /SDA	2	I/O	Output or input pin. To be input, active high.
OKY1/Vpp	3	I	Input pin, active high, or positive high power for programming.
IO2 /SCL	4	I/O	Output or input pin. To be input, active high.
PWM1	5	O	PWM output 1.
PWM2 /Mode	6	O	PWM output 2, or select programming mode.
VDD	7	Power	Positive power.
Vreg	8	Power	Regulator input. Connect a 0.1uF cap to GND or keep floating.

5. ABSOLUTE MAXIMUM RATING

Symbol	Rating	Unit
VDD~GND	-0.5 ~ +7.0	V
Vin	GND-0.3 <Vin <VDD+0.3	V
Vout	GND <Vout <VDD	V
Top (operating)	-20 ~ +70	ºC
Tst (storage)	-55 ~ +150	ºC

6. DC CHARACTERISTICS

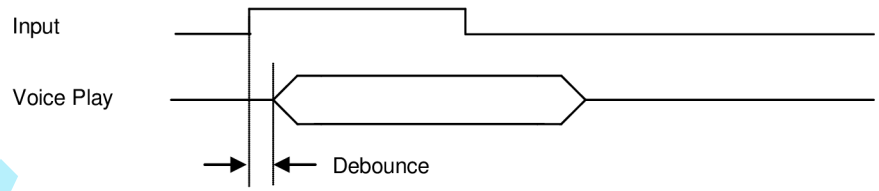
Symbol	Parameter	VDD	Min.	Typ.	Max.	Unit	Condition
VDD	Operating voltage	--	1.8	3.0	5.5	V	1.54MHz
ISB	Standby current	3.0		0.1	0.5	uA	LVR and POP disabled
		4.5		0.1	0.5		
		3.0		1.0			LVR or POP enabled
		4.5		2.0			
IOP	Operating current	3.0		0.4		mA	No load.
		4.5		0.7			
IIH	Input current (1.5M ohms pull-low)	3.0		2		uA	VIL=VDD
		4.5		5			
	Input current (300K ohms pull-low)	3.0		30		uA	
		4.5		85			
IOH	Output drive current	3.0		-7		mA	VOH=2.0V
		4.5		-11			VOH=3.5V
IOL	Output normal sink current	3.0		22		mA	VOL=1.0V
		4.5		33			
	Output large sink current	3.0		65		mA	
		4.5		85			
	Output constant sink current	3.0		20		mA	
		4.5		21			
IPWM	PWM output current (Normal)	3.0		60		mA	Load=8 ohms
		4.5		100			
	PWM output current (Large)	3.0		70		mA	
		4.5		117			
ΔF/F	Frequency deviation by voltage drop	3.0		0.1		%	Fosc(3.0v)-Fosc(2.4v) Fosc(3v)
		4.5		-0.1			Fosc(4.5v)-Fosc(3.0v) Fosc(4.5v)
	Frequency lot deviation	--	-0.5		0.5	%	Fmax(VDD)-Fmin(VDD) Fmax(VDD)
Fosc	Oscillation Frequency	--	1.50	1.54	1.58	MHz	VDD=1.8~5.5V



7. TIMING DIAGRAM

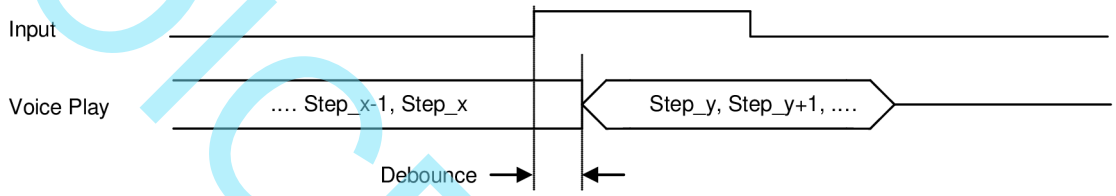
(1) Debounce Time

(a) *. Trigger while no playing voice*



* Debounce time is configured by 6.67 kHz S.R and the value is fixed. That is, Long debounce=31ms, Short debounce = 42us

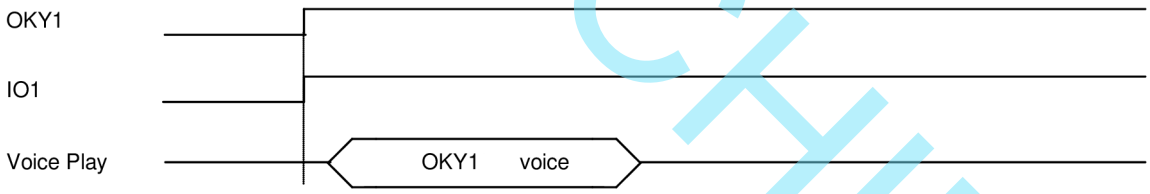
(b) *. Trigger While playing voice*



* Debounce Time is configured by the S.R. of Step_x. At S.R. = 6kHz, Long debounce = 45ms, Short debounce = 50us

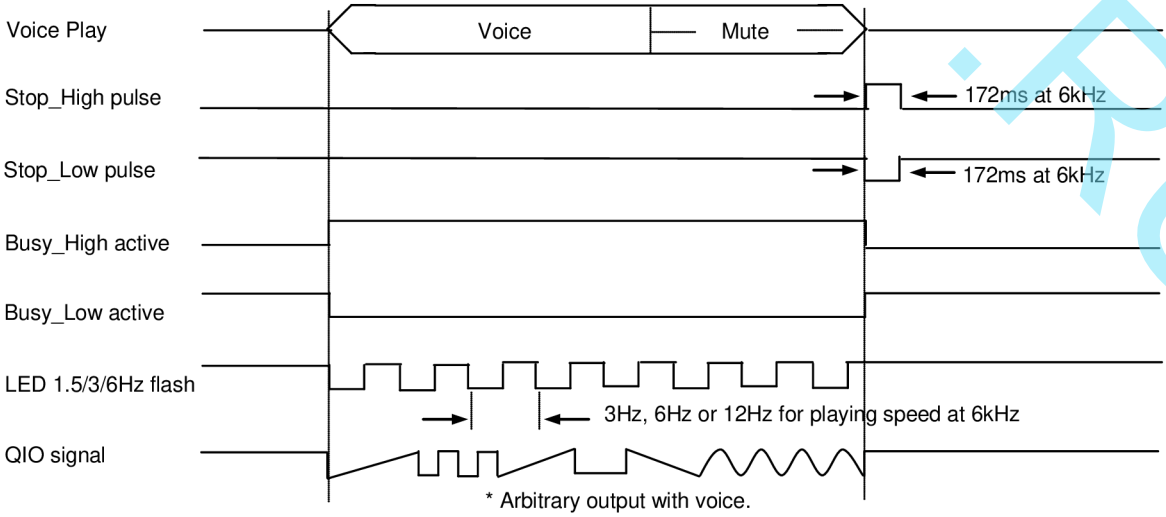
For example, if Step_x S.R. = 8kHz, Long debounce = 45ms*(6k/8k) = 15ms, Short debounce = 50us*(6k/8k) = 37.5us

(2) Input Priority



※ Priority: OKY1 > IO1 > IO2

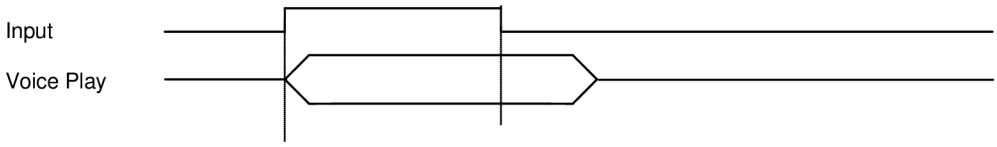
(3) Output Signal (IO1, IO2)



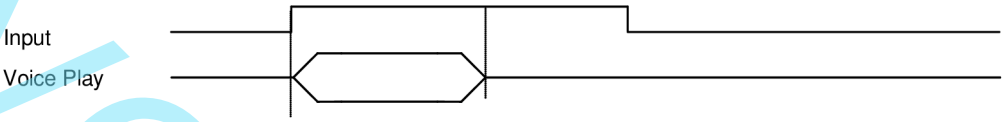
LED dynamic 1/2: When the voice amplitude is higher than 1/2 level, LED will be ON, i.e. output signal is low.

(4) Basic Operation

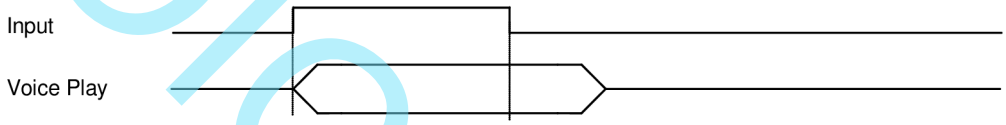
(a) . Edge mode, Edge trigger



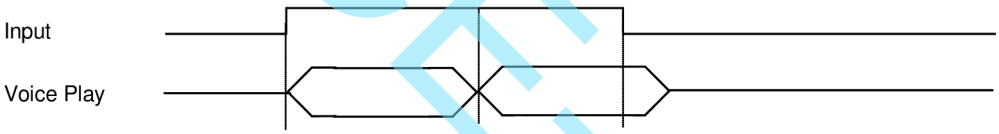
(b) . Edge mode, Level trigger



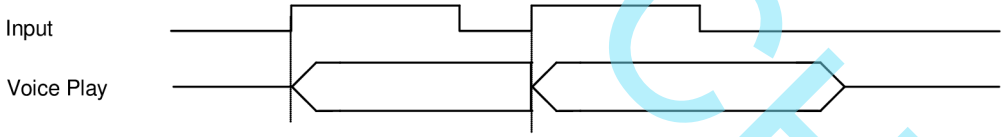
(c) . Level mode, Edge trigger



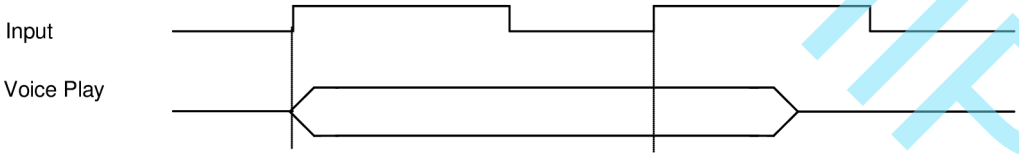
(d) . Level mode, Level trigger



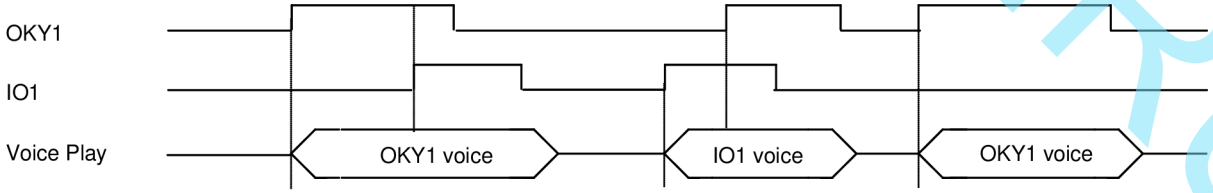
(e) . Retrigger mode



(f) . Irretrigger mode



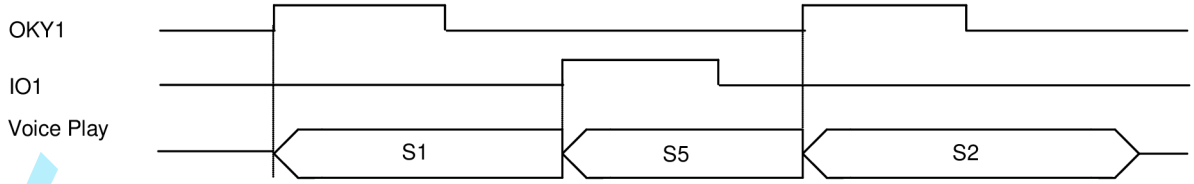
(g) . Retrigger mode, first key priority



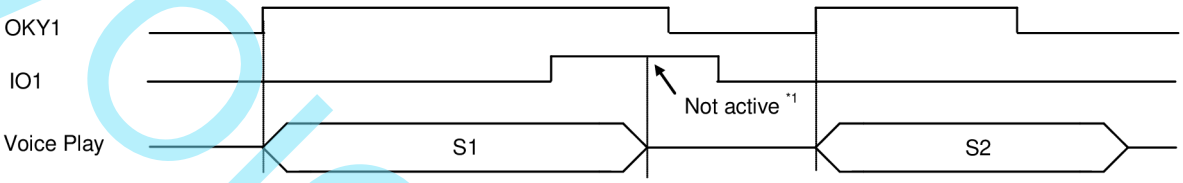
(5) Advanced Operation

(a). Different Input Reload *(OKY1 is in Sequential mode)*

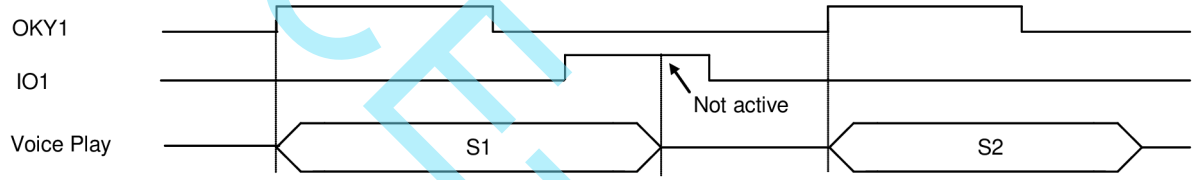
(a-1) OKY1 (E/U/R) = S1 S2 S3 S4, IO1(E/U/R) = S5 (S1 means Sentence 1)

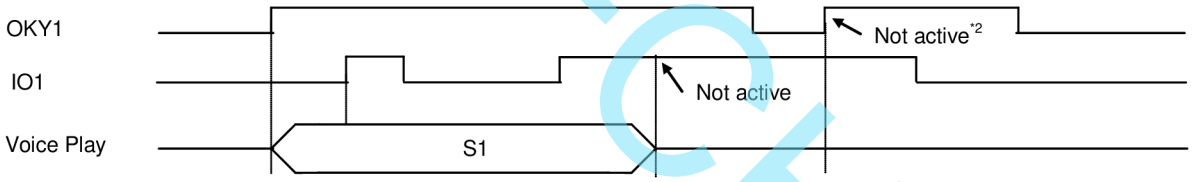


(a-2) OKY1 (E/U/R) = S1 S2 S3 S4, IO1 (L/x/x) = S5*1: If you press IO1 during OKY1 voice playing, at the moment of S1 end, the trigger mode follows OKY1



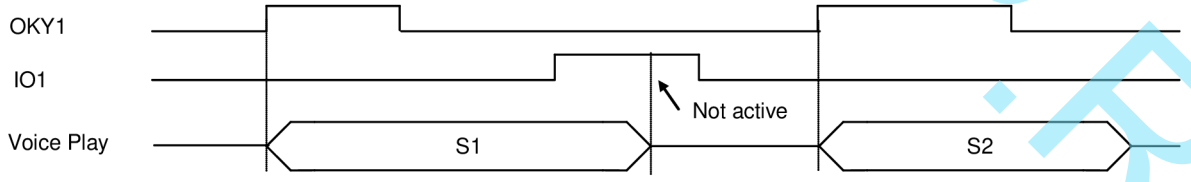
(a-3) OKY1 (E/U/I) = S1 S2 S3 S4, IO1 (E/x/x) = S5



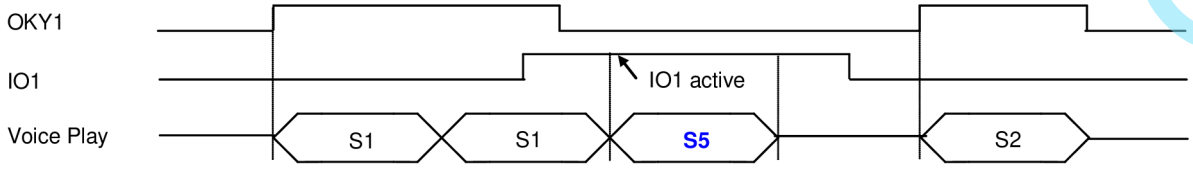


*2: Because IO1 signal is still high in the same time IC can't accept the OKY1 Edge signal.

(a-4) OKY1 (E/U/I) = S1 S2 S3 S4, IO1 (L/x/x) = S5



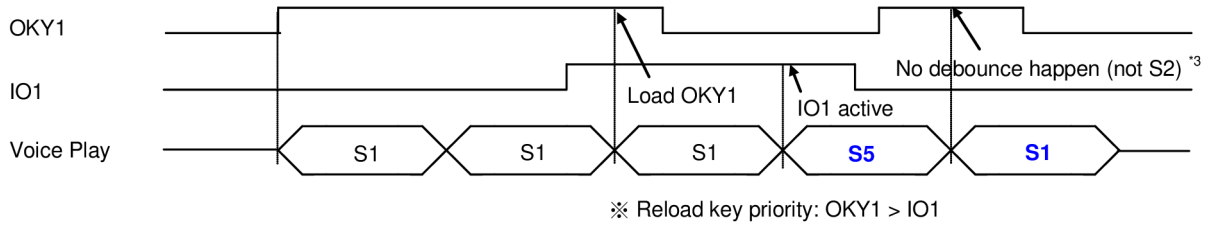
(a-5) OKY1 (L/U/x) = S1 S2 S3 S4, IO1 (E/x/x) = S5



※ In the time of Sentence end: When S1 end, the trigger mode follows OKY1 (L/U/x). When S5 end, it follows IO1 (E/x/x).

※ Once S5 is played (just leave S1 ending), the trigger mode follows IO1 (E/x/x) immediately.

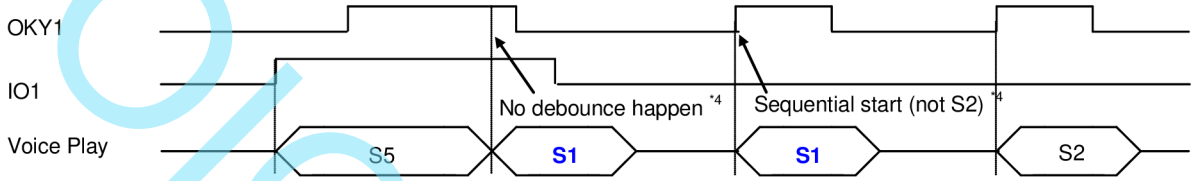
(a-6) OKY1 (L/U/x) = S1 S2 S3 S4, IO1 (L/U/I) =S5



※ Reload key priority: OKY1 > IO1

**3: In OKY1 mode, Sequential number is counted only if there is debounce happened.*

(a-7) OKY1 (L/U/x) = S1 S2 S3 S4, IO1 (L/U/I) =S5

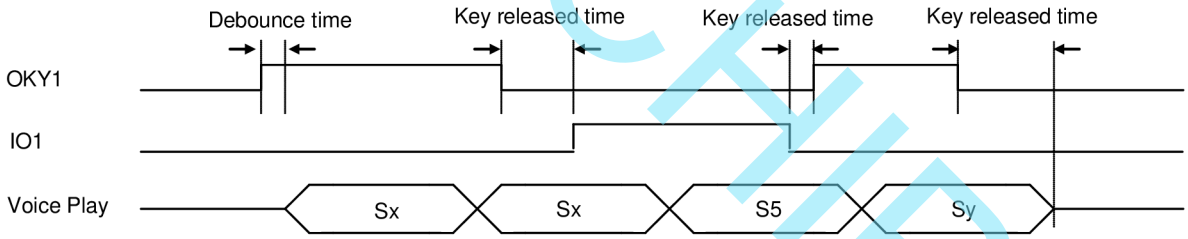


*4: In OKY mode, 1st trigger without debounce and Sequential number is still "1". 2nd trigger with debounce, after trigger the Sequential number become "2".

(b). Random Function

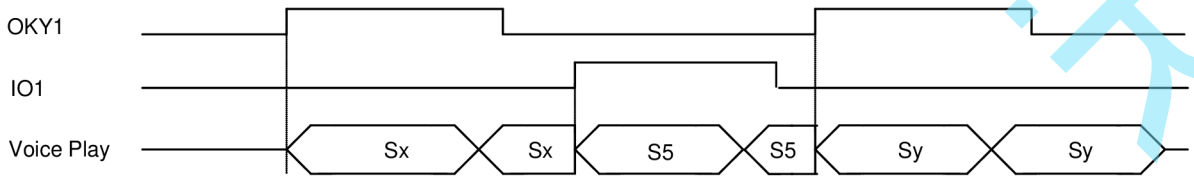
(b-1) OKY1 (L/U/I) =S1 S2 S3 S4, IO1 (L/U/I) =S5

Random (or Sequential) number is counted during "debounce time" or "key released time". But the first-time trigger only relies on "debounce time" due to no "key release time".



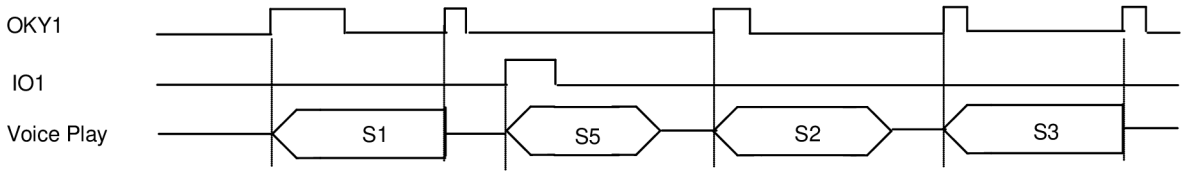
x=1, 2, 3 or 4; y=1, 2, 3 or 4 (x and y are random number)

(b-2) OKY1 (L/U/R) =S1 S2 S3 S4, IO1 (L/U/R) =S16

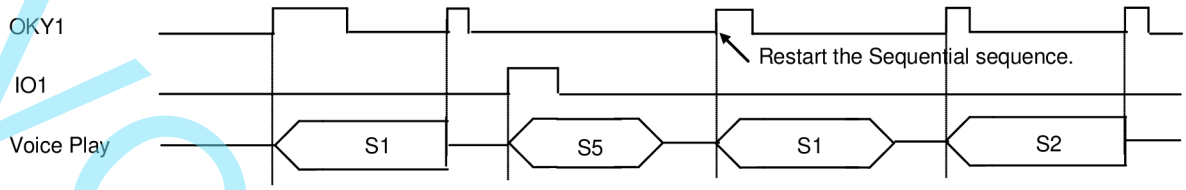


(c). Toggle On/Off Function

(c-1) OKY1 (E/U/R) =S1 S2 S3 S4, IO1 (E/U/R) =S5 (OKY1 is Sequential mode without Reset)



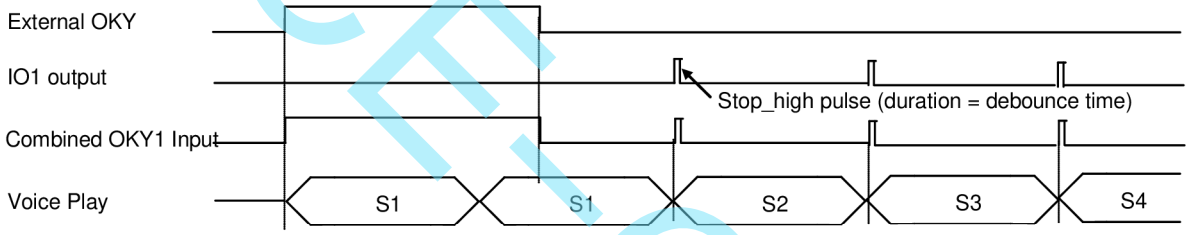
(c-2) OKY1 (E/U/R) =S1 S2 S3 S4, IO1 (E/U/R) =S16 (OKY1 is Sequential mode with Reset)



※ When OKY1 Sequential counter is going, to trigger other inputs will reset OKY1 Sequential sequence.

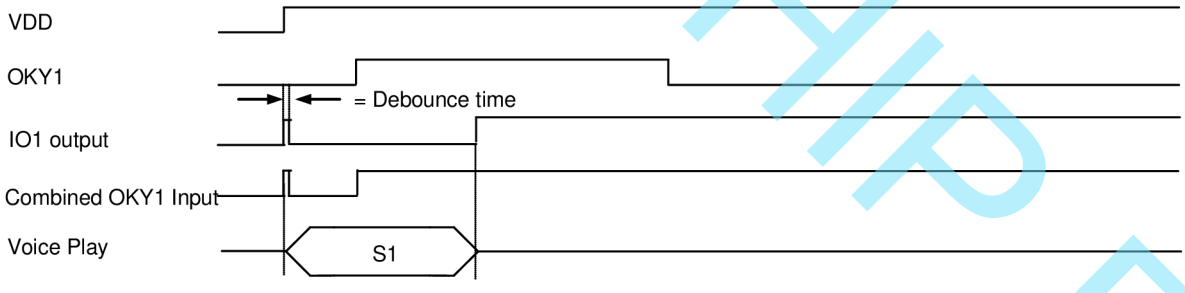
(d). External Feedback Function *(IO1 is output and connected to OKY1 input)*

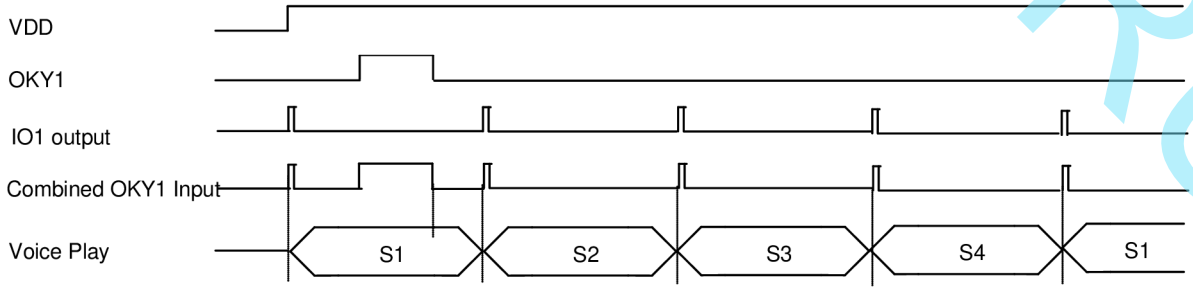
(d-1) OKY1 (L/U/I) =S1 S2 S3 S4, IO1=Stop_high pulse (When voice ends, IO1 shows a high pulse.)



※ Originally the duration of Stop_high pulse is 172ms at 6kHz, but the high signal will trigger voice and turn low after debounce.

(d-2) OKY1 (E/U/I) = S1 S2 S3 S4, IO1= Busy_low (When not playing voice, IO1 is high.)





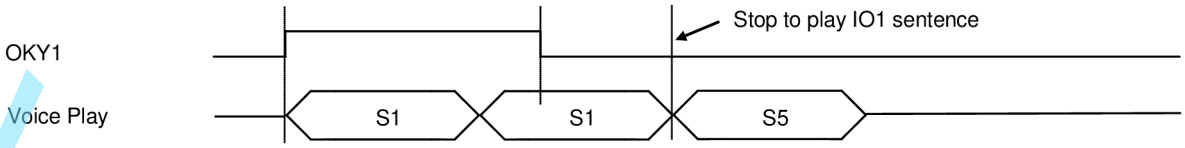
※ When power on, IO1 will generate a high pulse at Busy_low status and the duration is equal to debounce time.

(e). Internal-Feedback Function *(OKY1 is fixed as input)*

Each sentence can assign an Internal-Feedback Path to play a fixed sentence after IO's sentence stop.

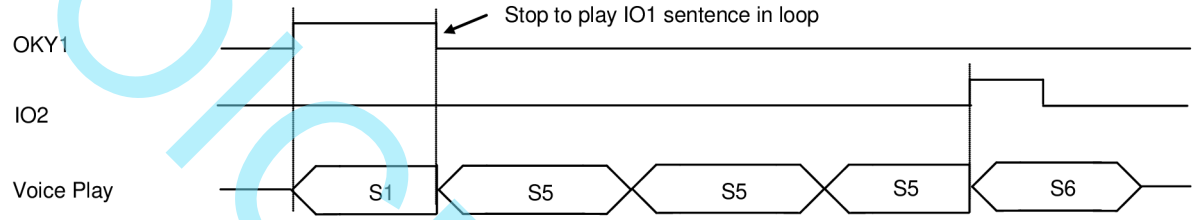
(e-1) OKY1 (L/U/I) = S1 S2 S3 S4, OKY2 = S5, Internal-Feedback Path = OKY1 -> OKY2

If S1 is optioned with Internal-Feedback Path,



(e-2) OKY1 (L/H/I) = S1 S2 S3 S4, OKY2 (x/x/R) = S5, IO2 (E/U/I) = S6, Internal-Feedback Path = OKY1 -> OKY2

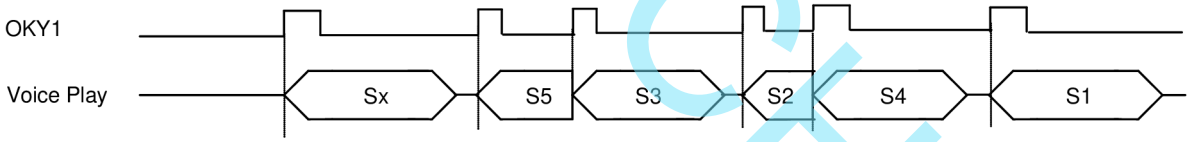
If both S1 and S5 are optioned with Internal-Feedback Path,



(f). Table-Random Function

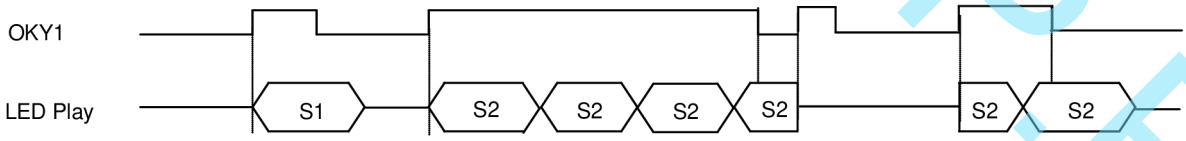
When power in on, a random number is counted automatically. The first-time trigger will play the sentence of random number (Sx), and the next trigger will be sequential.

(f-1) OKY1 (E/U/R) = S3 S2 S5 S4 S1 S3 S2 ……. Sx S5 S3 S2 S4 S1 S3 S2 S5 S1 S4 S5 S3 S1 S2

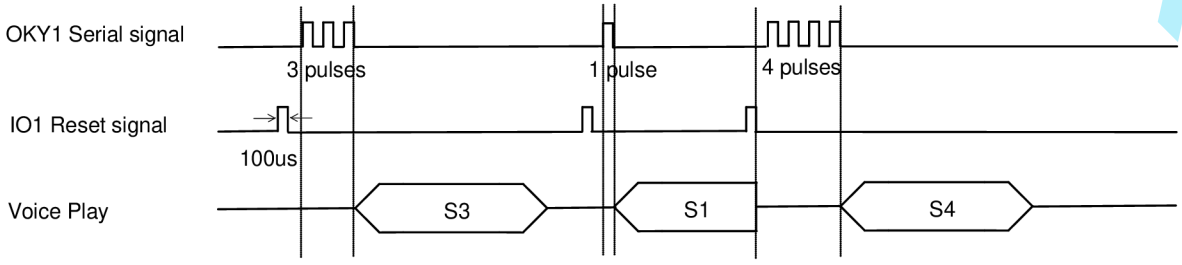


(g). Pause-Resume Function

(g-1) OKY1 (L/U/R) = S1 S2



(i). Serial-Trigger Function (All inputs must be set as short debounce)

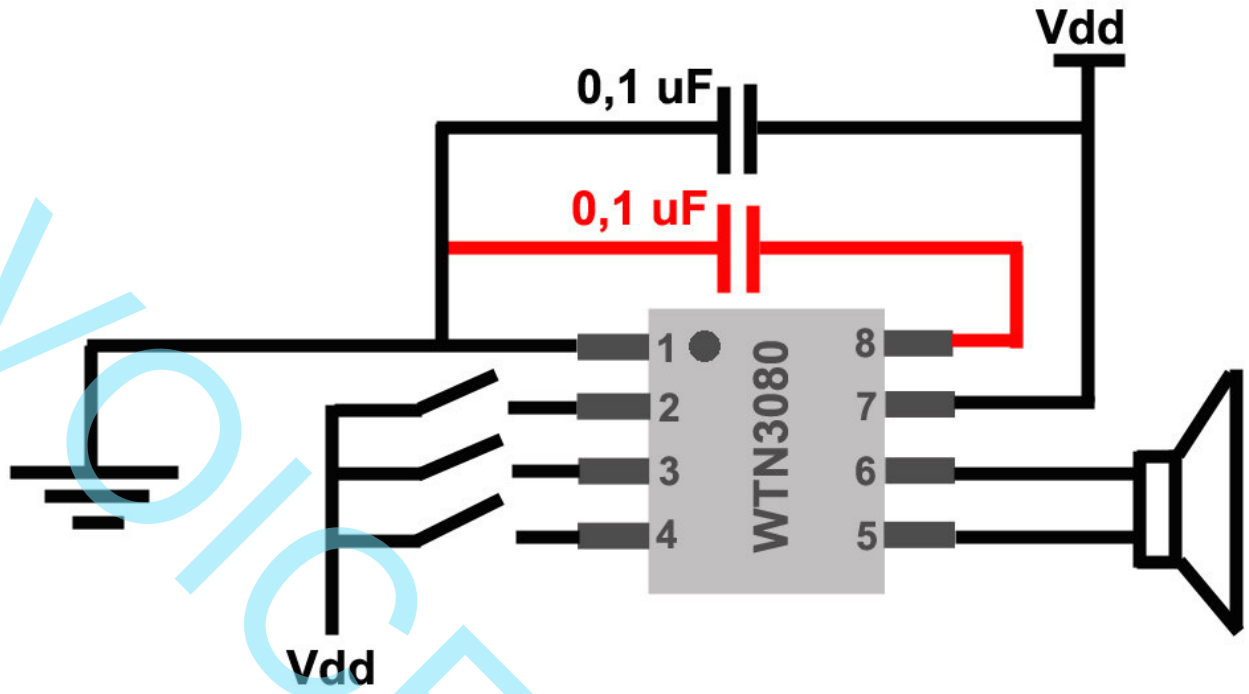


※ The pulse width must be longer than 50us (i.e. short debounce time), and users can set the typical pulse width as 100us.

※ The above is the simplest 2-wire control by external MCU. If necessary, user can use 3-wire control with Busy_High output signal to do feedback.

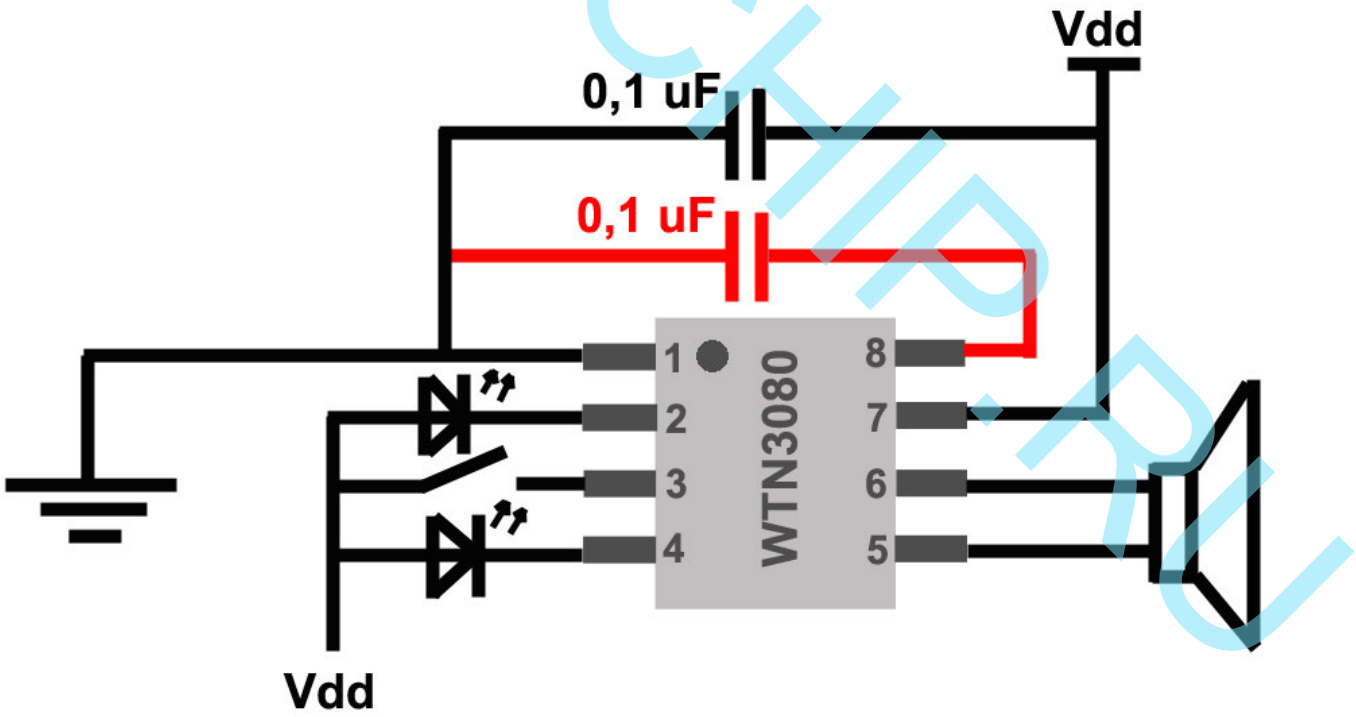
8. TYPICAL APPLICATION CURCUIT

8.1. Three triggers.



** Note: At supply of 4.5V or higher voltage, Vreg must be connected to GND with a 0.1 uF cap for lesser power noise. At 3V Vreg doesn't need to connect any capacitor and can be kept this pad floating to save a capcitor.*

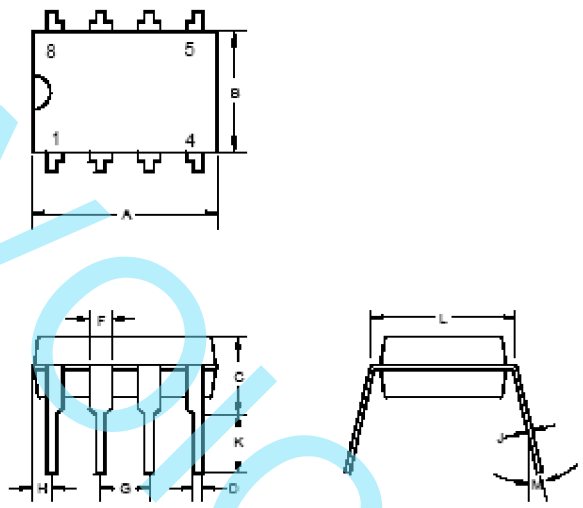
8.1. One trigger with two LEDs.



** Note: At supply of 4.5V or higher voltage, Vreg must be connected to GND with a 0.1 uF cap for lesser power noise. At 3V Vreg doesn't need to connect any capacitor and can be kept this pad floating to save a capcitor.*

9. PACKAGE DIMENSIONS

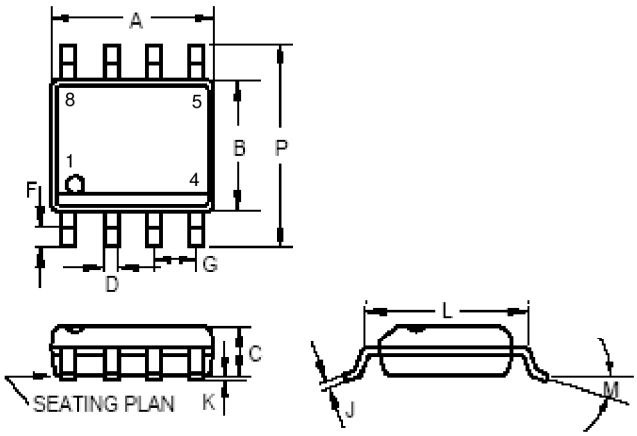
8-Pin Plastic DIP (300 mil)



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.355	0.365	0.400	9.02	9.27	10.16
B	0.240	0.250	0.280	6.10	6.35	7.11
C	-	-	0.210	-	-	5.33
D	-	0.018	-	-	0.46	-
F	-	0.060	-	-	1.52	-
G	-	0.100	-	-	2.54	-
H	0.050	-	0.090	1.27	-	2.29
J	0.008	-	0.015	0.20	-	0.38
K	0.115	0.130	0.150	2.92	3.30	3.81
L	0.300 BSC.			7.62 BSC.		
M	-	7°	15°	-	7°	15°

Note: For 8-pin Plastic package, 50 units per tube.

8-Pin Plastic SOP (150 mil)



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.183	-	0.202	4.65	-	5.13
B	0.144	-	0.163	3.66	-	4.14
C	0.068	-	0.074	1.35	-	1.88
D	0.010	-	0.020	0.25	-	0.51
F	0.015	-	0.035	0.38	-	0.89
G	0.050 BSC			1.27 BSC		
J	0.007	-	0.010	0.19	-	0.25
K	0.005	-	0.010	0.13	-	0.25
L	0.189	-	0.205	4.80	-	5.21
M	-	-	8°	-	-	8°
P	0.228	-	0.244	5.79	-	6.20

Note: For 8-pin S.O.I.C., 100 units per tube.