PRELIMINARY

3sec PIEZO BUZZER DIRECT DRIVE VOICE SYNTHESIZER

■ GENERAL DESCRIPTION

The NJU5511 series is a PCM method voice synthesizer which consists of 108k bits data ROM, ladder type D/A converter, CR oscillator and control logics.

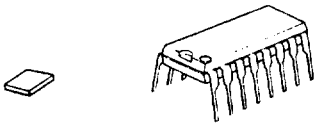
The operating voltage of 2.4V or over enables the operation using a small button cell or other types batteries.

The 108k bits data ROM can be divided into two independent sections of any desired length, and sounds of human and animal voices or other kinds of sound effects can be programmed up to 3 sec in total.

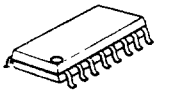
The ladder type D/A converter can drive a dynamic speaker by using simple external amplifier.

The NJU5511 can be applied to the thinnest and smallest voice synthesis modules as it requires one resistor only as external components. Consequently, it can widely be utilized for applications in the consumer field.

■ PACKAGE OUTLINE



NJU5511CXX NJU5511DXX

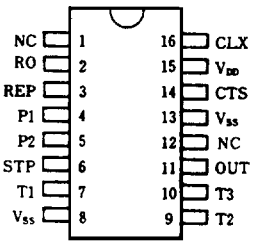


NJU5511MXX

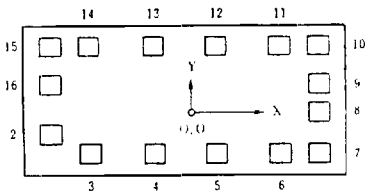
■ FEATURES

- Synthesis Method : 6 bits PCM
- Sampling Rate : 6 kHz
- Internal ROM size : 108k bits
- Synthesis Time : 3.0 seconds (MAX)
- D/A Converter : Ladder Type (Voltage Mode)
- Divided ROMs Output 2 kinds of Voice or Sound Effects
- One-Shot with Repeat and Level-Hold Mode
- Piezo Buzzer Direct Drive
- Minimum External Components
- Low Current Consumption
- Power Save Function : Oscillation Stop After Replay
  Value Shifted Pull-down Resistance
- Operating Voltage : 2.4V ~ 5.4V
- Package Outline : DIP 16 / DMP 16 / CHIP 16
- C-MOS Technology

■ PIN CONFIGURATION



■ PAD LOCATION



CHIP SIZE : 2.46 X 3.9mm
CHIP THICKNESS : 400μm±30μm

■ COORDINATES

(UNIT: μm)

NO	X	Y	NO	X	Y
1	-	-	9	1760	250
2	-1760	- 420	10	1760	790
3	-1010	-1050	11	1300	1040
4	- 570	-1050	12	870	1040
5	930	-1050	13	- 910	1040
6	1410	-1050	14	-1390	1040
7	1760	- 860	15	-1760	590
8	1760	- 520	16	-1760	250

■ RECOMENDED OSCILLATION RESISTER

Supply Volage	Resistance	Osc. Frequency
3.0 V	27kΩ	769kHz
4.5 V	30kΩ	769kHz
5.0 V	31kΩ	769kHz

■ TERMINAL DESCRIPTION

NO	SYMBOL	F U N C T I O N
1	NC	Non connection
2	RO	CR Oscillation Terminal (External resistor connecting terminal)
3	REP	Repeat, Pause Input Terminal (With Pull-down Resistor)
4	P1	Section 1 Trigger Signal Input Terminal (With pull-down resistor)
5	P2	Section 2 Trigger Signal Input Terminal (With pull-down resistor)
6	STP	END Signal Output Terminal
7	T1	Testing Terminal (Normally OPEN)
8	V_{SS}	V_{SS} Connecting Terminal
9	T2	Testing Terminal (Normally OPEN)
10	T3	Testing Terminal (Normally OPEN)
11	OUT	Voice Signal Output Terminal (PWM signal output)
12	NC	Non Connection
13	V_{SS}	V_{SS} Connecting Terminal
14	CTS	Level Hold/One Shot Selecting Terminal
15	V_{DD}	V_{DD} Connecting Terminal
16	CLX	CR Oscillation Terminal (External resistor connecting terminal)

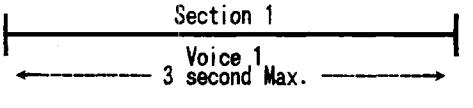
■ FUNCTIONAL DESCRIPTION

(1) ROM Section

The NJU5511 incorporated 108K bits data ROM which can be programmed for up to 3 sec. The 108K bits data ROM can be divided into two independent sections of any desired length, and two kinds of voice or sound effects can be programmed up to 3 sec. in total.

① One kind of voice

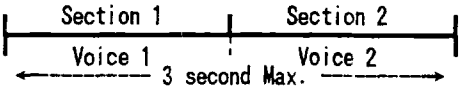
In case of one kind of voice is programmed, P1 and P2 terminals trigger same section.



Trigger Terminal	Output Voice
P1 P2	Section 1 Section 1

② Two kinds of voices

In case of the ROM is divided into two independent sections and 2 kinds of voices are programmed. Section 1 and section 2 are triggerd by terminal P1 and P2 respectively.



Trigger Terminal	Output Voice
P1 P2	Section 1 Section 2

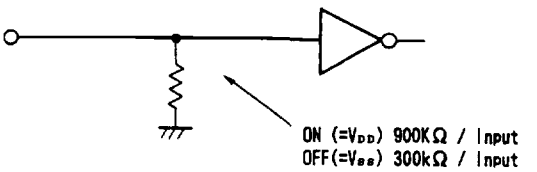
(2) Replay Function

The combination of P1, P2, REP and CTS can select the following replay mode.

<table>
<tr><th>TERMINAL</th><th>LEVEL</th><th>F U N C T I O N</th></tr>
<tr><td>P1, P2</td><td></td><td>P1 to P4 trigger the following sect ion.
<table>
<tr><th>Select Term.</th><th>1 Kind Voice</th><th>2 Kinds Voice</th></tr>
<tr><td>P1
P2</td><td>Section 1
Section 1</td><td>Section 1
Section 2</td></tr>
</table>
One Shot or Level Hold Mode is deter mind by CTS terminal.</td></tr>
<tr><td rowspan="2">REP</td><td>V_{DD}</td><td>Performing the number of repeat times of preset.
The number of repeat times of section 1 and 2 can be set independantly.
The number of repeat times is mask option:
Repeat times...N=0～7 times
One of pause time can select from 1.25secxM (M=0～3 times)</td></tr>
<tr><td>V_{SS}</td><td>REPEAT is not operated.</td></tr>
<tr><td rowspan="2">CTS</td><td>V_{DD}</td><td>One Shot Mode is selected
The voice replay only one cycle even if either one of the P1 and P2 input over one cycle times.
However, it performs the number of repeat times of preset when REP=V_{DD}.</td></tr>
<tr><td>V_{SS}</td><td>Level Hold Mode is selected
The voice replay during either one of P1 and P2 is input. If the input is released halfway of the replay, the replay is performd compleatry to the end of cycles.</td></tr>
</table>

Note: REP and CTS terminals must to be connected to V_{DD} or V_{SS}. (OPEN may cause error operation)

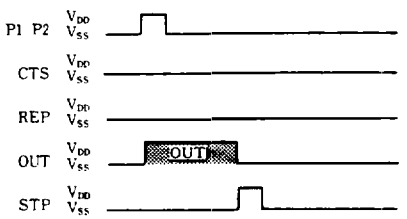
<Input terminal structure>



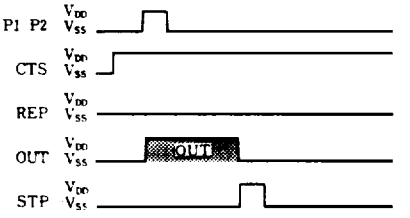
■ TIMING CHART

① One kind of voice replay

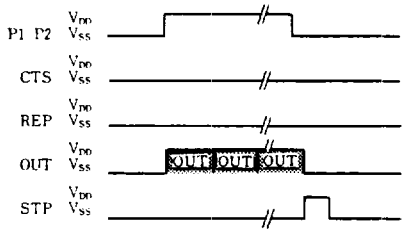
(1-1)Level Hold Mode (CTS"L")



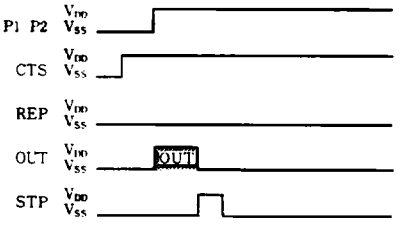
(1-2)One-Shot Mode (CTS"H")



(2-1)Level Hold Mode (CTS"L")

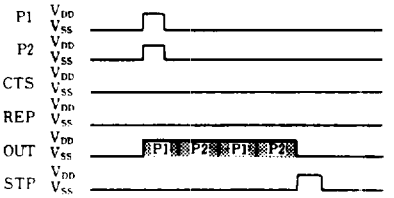


(2-2)One-Shot Mode (CTS"H")

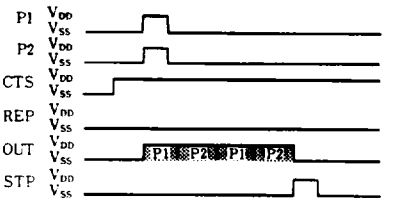


② Two kinds of voices replay

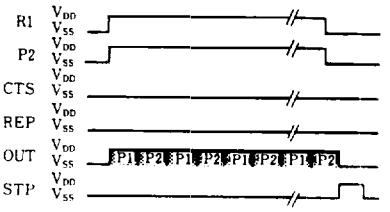
(1-1)Level Hold Mode (CTS"L")



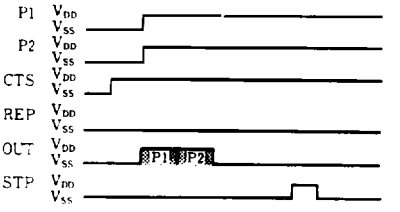
(1-2)One-Shot Mode (CTS"H")



(2-1)Level Hold Mode (CTS"L")



(2-2)One-Shot Mode (CTS"H")



Note 1) The input pulse width must be more than 64msec. (If it is less than 64msec. error operation will occur).
Note 2) The pulse width of STP output signal is about 64 msec.
Note 3) When the input is released, voice will be performed till the end of replaying section.
Note 4) When repeat mode is selected (mask option), there is different output occur by the number of REPEAT/PAUSE times.

(3) Repeat Playing Function

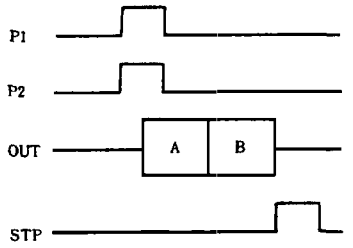
The number of repeat times can be set independently for each section to output effectively voice, in this time only one fixed pause time is available for all sections.

<The ROM divided into two sections example>

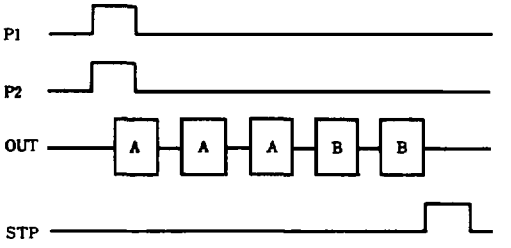
ITEM	SECTION 1	SECTION 2
Output Voice	A	B
Repeat Times	3	2
Pause Time	1.25 second(Common)	

1) In case of one-shot mode

①CTS="H", REP="L"

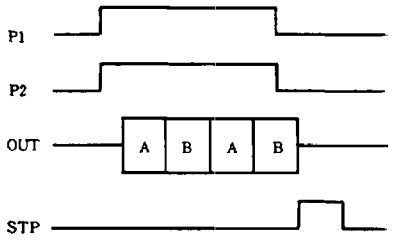


②CTS="H", REP="H"

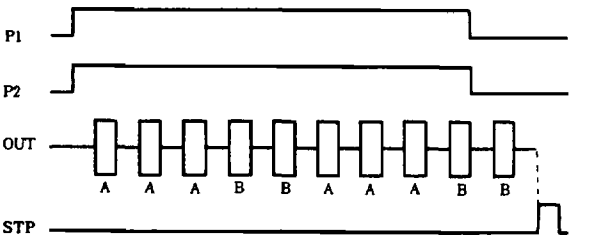


2) In case of level hold mode

①CTS="L", REP="L"



②CTS="L", REP="H"



STP signal output after pause time(1.25sec)

Above timing charts is example of dividing ROM into two sections and control by P1 and P2.

■ TERMINAL DESCRIPTION

NO	SYMBOL	F U N C T I O N
1	NC	Non connection
2	RO	CR Oscillation Terminal (External resistor connecting terminal)
3	REP	Repeat, Pause Input Terminal (With Pull-down Resistor)
4	P1	Section 1 Trigger Signal Input Terminal (With pull-down resistor)
5	P2	Section 2 Trigger Signal Input Terminal (With pull-down resistor)
6	STP	END Signal Output Terminal
7	T1	Testing Terminal (Normally OPEN)
8	V_{SS}	V_{SS} Connecting Terminal
9	T2	Testing Terminal (Normally OPEN)
10	T3	Testing Terminal (Normally OPEN)
11	OUT	Voice Signal Output Terminal (PWM signal output)
12	NC	Non Connection
13	V_{SS}	V_{SS} Connecting Terminal
14	CTS	Level Hold/One Shot Selecting Terminal
15	V_{DD}	V_{DD} Connecting Terminal
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■ FUNCTIONAL DESCRIPTION

(1) ROM Section

The NJU5511 incorporated 108K bits data ROM which can be programmed for up to 3 sec. The 108K bits data ROM can be divided into two independent sections of any desired length, and two kinds of voice or sound effects can be programmed up to 3 sec. in total.

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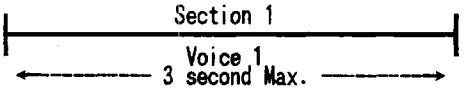
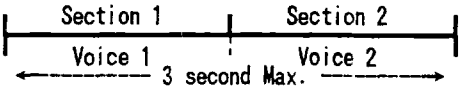


Trigger Terminal	Output Voice
P1 P2	Section 1 Section 1

② Two kinds of voices

In case of the ROM is divided into two independent sections and 2 kinds of voices are programmed. Section 1 and section 2 are triggerd by terminal P1 and P2 respectively.



Trigger Terminal	Output Voice
P1 P2	Section 1 Section 2

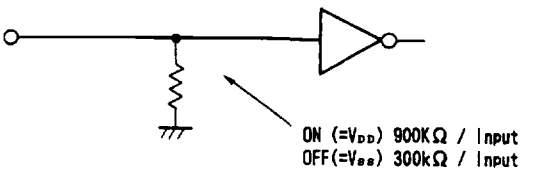
(2) Replay Function

The combination of P1, P2, REP and CTS can select the following replay mode.

<table>
<tr><th>TERMINAL</th><th>LEVEL</th><th>F U N C T I O N</th></tr>
<tr><td>P1, P2</td><td></td><td>P1 to P4 trigger the following sect ion.
<table>
<tr><th>Select Term.</th><th>1 Kind Voice</th><th>2 Kinds Voice</th></tr>
<tr><td>P1
P2</td><td>Section 1
Section 1</td><td>Section 1
Section 2</td></tr>
</table>
One Shot or Level Hold Mode is deter mind by CTS terminal.</td></tr>
<tr><td rowspan="2">REP</td><td>V_{DD}</td><td>Performing the number of repeat times of preset.
The number of repeat times of section 1 and 2 can be set independantly.
The number of repeat times is mask option:
Repeat times...N=0～7 times
One of pause time can select from 1.25secxM (M=0～3 times)</td></tr>
<tr><td>V_{SS}</td><td>REPEAT is not operated.</td></tr>
<tr><td rowspan="2">CTS</td><td>V_{DD}</td><td>One Shot Mode is selected
The voice replay only one cycle even if either one of the P1 and P2 input over one cycle times.
However, it performs the number of repeat times of preset when REP=V_{DD}.</td></tr>
<tr><td>V_{SS}</td><td>Level Hold Mode is selected
The voice replay during either one of P1 and P2 is input. If the input is released halfway of the replay, the replay is performd compleatry to the end of cycles.</td></tr>
</table>

Note: REP and CTS terminals must to be connected to V_{DD} or V_{SS}. (OPEN may cause error operation)

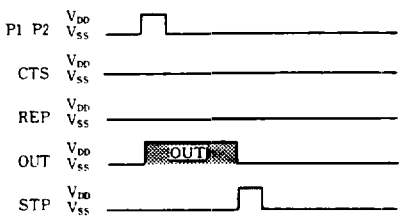
<Input terminal structure>



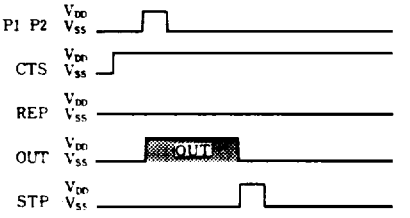
■ TIMING CHART

① One kind of voice replay

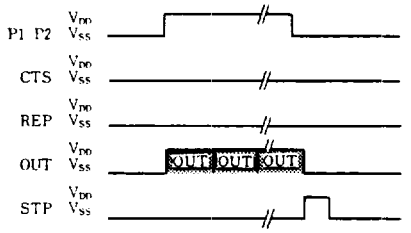
(1-1)Level Hold Mode (CTS"L")



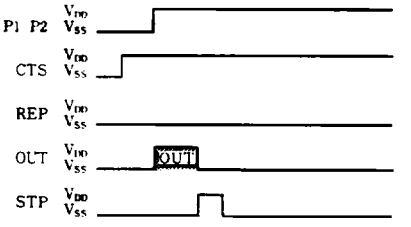
(1-2)One-Shot Mode (CTS"H")



(2-1)Level Hold Mode (CTS"L")

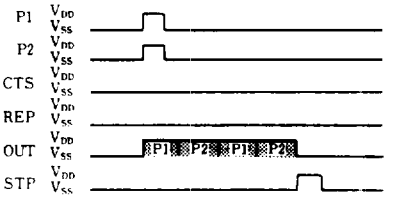


(2-2)One-Shot Mode (CTS"H")

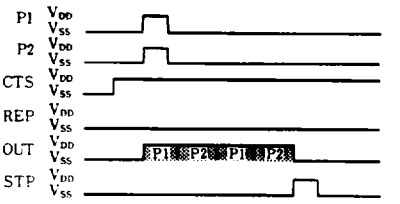


② Two kinds of voices replay

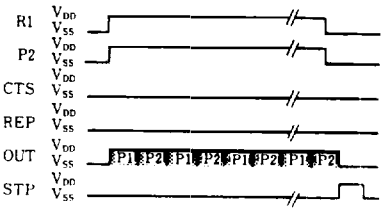
(1-1)Level Hold Mode (CTS"L")



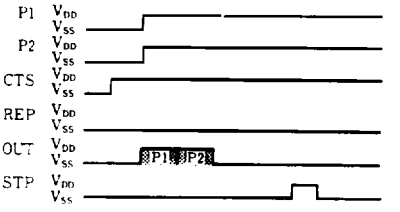
(1-2)One-Shot Mode (CTS"H")



(2-1)Level Hold Mode (CTS"L")



(2-2)One-Shot Mode (CTS"H")



Note 1) The input pulse width must be more than 64msec. (If it is less than 64msec. error operation will occur).
Note 2) The pulse width of STP output signal is about 64 msec.
Note 3) When the input is released, voice will be performed till the end of replaying section.
Note 4) When repeat mode is selected (mask option), there is different output occur by the number of REPEAT/PAUSE times.

(3) Repeat Playing Function

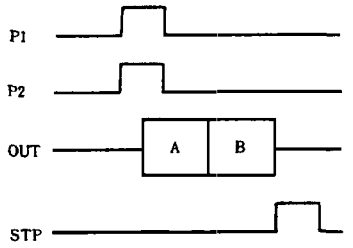
The number of repeat times can be set independently for each section to output effectively voice, in this time only one fixed pause time is available for all sections.

<The ROM divided into two sections example>

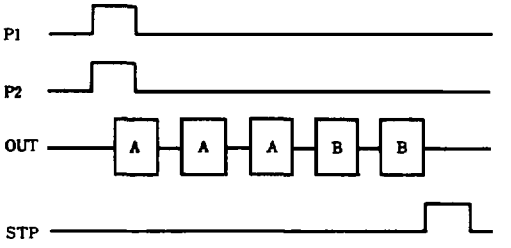
ITEM	SECTION 1	SECTION 2
Output Voice	A	B
Repeat Times	3	2
Pause Time	1.25 second(Common)	

1) In case of one-shot mode

①CTS="H", REP="L"

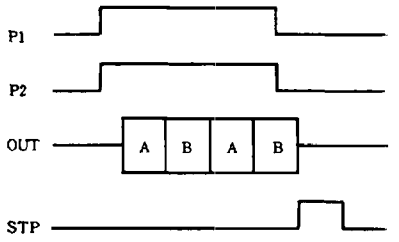


②CTS="H", REP="H"

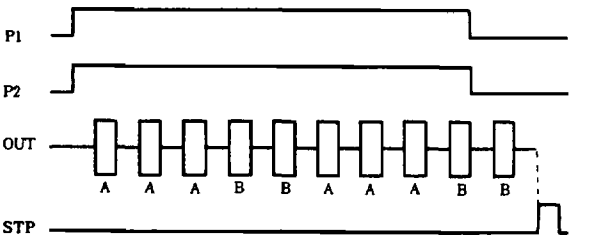


2) In case of level hold mode

①CTS="L", REP="L"



②CTS="L", REP="H"



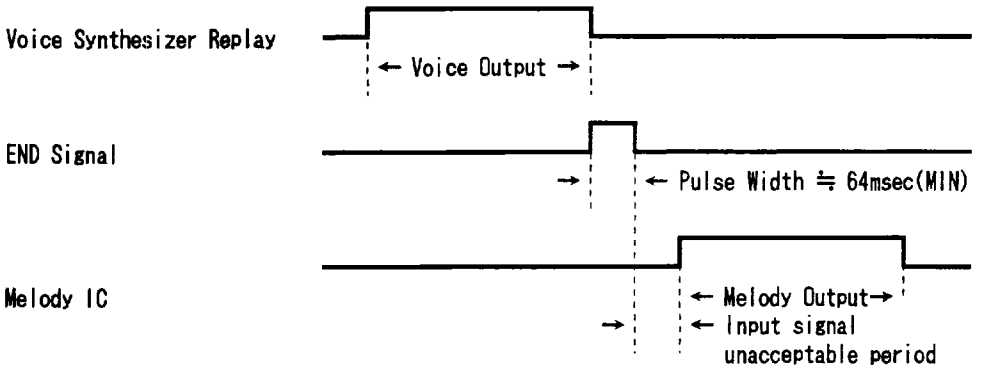
STP signal output after pause time(1.25sec)

Above timing charts is example of dividing ROM into two sections and control by P1 and P2.

(4) END Signal Output

After the replay, about 64msec pulse width of END signal is output from STP terminal. This signal can be used as trigger signal for melody IC or others.

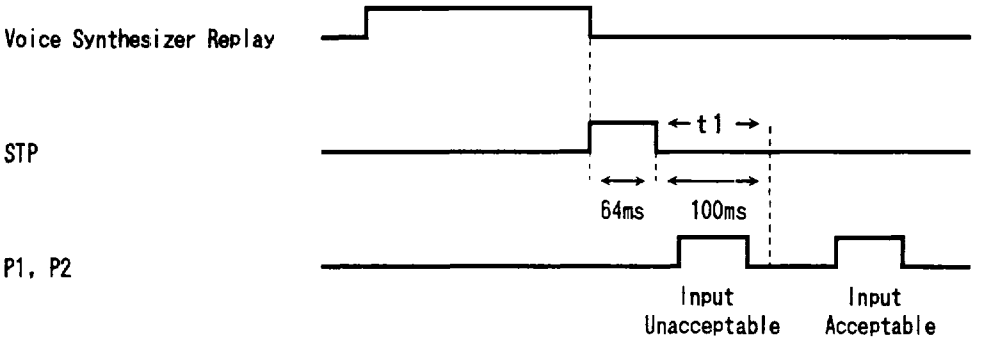
<Melody IC trigger example>



(5) Unacceptable period of Input Signal

The NJU5511 unaccept the any input during 100ms after STP signal output because of the LSI shift to the stand-by (Power saving) mode which stop the oscillation.

Therefore, retrigger should be input 100ms after STP signal output.



t1: The unacceptable period of input signal (about 100ms)

(6) Power-Saving Function

- Oscillation-Stop Function.....After voice replay, the oscillation is stop automatically and the current consumption becomes 0.1μA MAX.
- Input Current Control Function.....The pull-down resistors of P1, P2, P3, P4 and REP are changed according to the input level shown below:

  ON (=V_{DD}) 900KΩ / Input

  OFF(=V_{SS}) 300kΩ / Input

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}-V_{SS}	- 0.5 ~ + 7.0	V
Input Voltage	V_{IN}	V_{SS}-0.3 ~ V_{DD}+0.3	V
Output Voltage	V_{OUT}	V_{SS}-0.3 ~ V_{DD}+0.3	V
Operating Temperature	Topr	- 20 ~ + 70	℃
Storage Temperature	Tstg	- 55 ~ + 125	℃

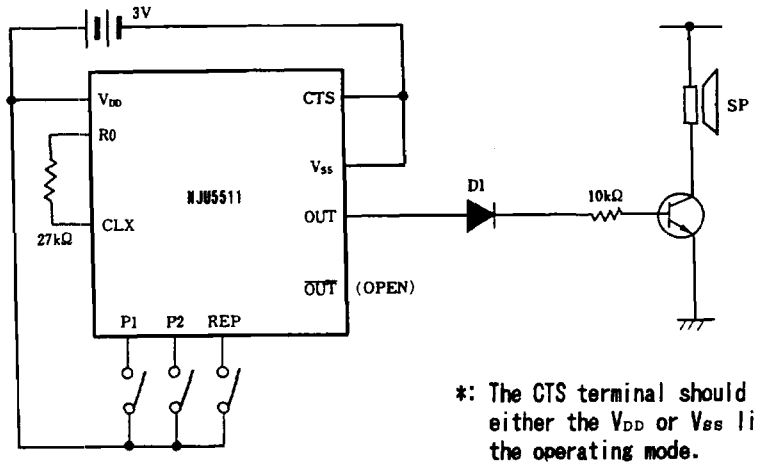
■ ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=3.0V, V_{SS}=0V)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Operating Voltage	V_{DD}			2.4		5.4	V
Stand-by Current	I_{DD1}				0.01	0.1	μA
Operating Current	I_{DD2}	OUT, Open			3.0	5.0	mA
Oscillation Frequency	F_{OSC}	R=27kΩ, VDD = 3V		650	768		kHz
Input Voltage	V_{IH}			V_{DD}-0.3		V_{DD}	V
	V_{IL}			V_{SS}		V_{SS}+0.3	
Input Current (Power Saving Mode)	I_{IH1}	VIH=2.2V, P1-P4, REP, CTS			3.0	10.0	μA
	I_{IL1}	VIL=0.8V, P1-P4, REP, CTS			3.0	10.0	
Input Current (C-MOS Input)	I_{IH2}	CTS	V_{IH}=2.2V		0.01	0.1	μA
	I_{IL2}		V_{IL}=0.8V		0.01	0.1	
Output Current	I_{OH1}	OUT	V_{OH}=1.5V	1.0	2.0		mA
	I_{OL1}		V_{OL}=1.5V	1.0	2.0		
	I_{OH2}	STP	V_{OH}=2.2V	0.7	1.0	1.3	mA
	I_{OL2}		V_{OL}=0.8V	0.7	1.0	1.3	

■ APPLICATION CIRCUITS

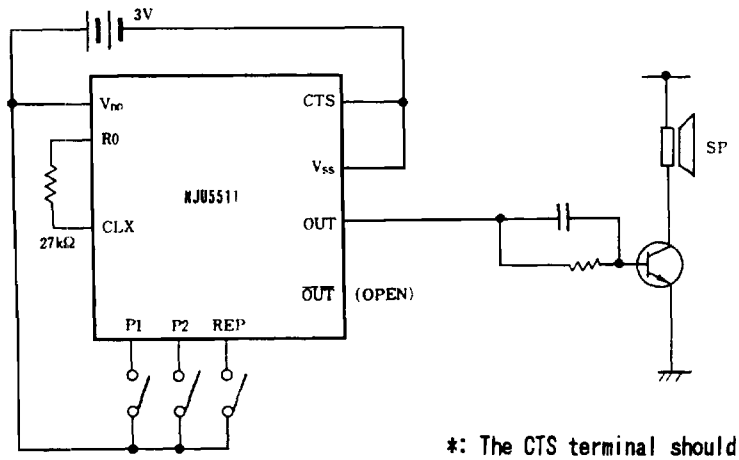
(1) Dynamic Speaker Drive



*: The CTS terminal should be connected to either the V_{DD} or V_{SS} line according to the operating mode.

D1: Prevention of click noises

(2) Dynamic Speaker Drive



*: The CTS terminal should be connected to either the V_{DD} or V_{SS} line according to the operating mode.