

## YMU277

### FM MUSIC Player L (FM MUSIC L)

#### ■ OVERVIEW

The YMU277 is a low-voltage operation custom LSI for automatic playback employing FM sound source.

The timbre and melody data are stored in a ROM.

4 melodies in a maximum of 255 steps are stored in the chip.

Integrated DAC and crystal oscillator permit the construction of a high sound quality, low-cost automatic playback system with few peripheral components.

The YMU277 is compatible with the timbre and melody data of the YMU251 (FM MUSIC 2).

#### ■ FEATURES

- Realistic sound by 2 operator FM sound source.
- 3-octaves sound range.
- Up to 4 sounds with different timbres can be generated.
- Musical performance data for up to 4 melodies within 255 steps.
- Up to 4 timbres can be set for 1 melody (or 1 phrase) .
- Maximum of 8 timbre presets for 8 melodies.  
(14 timbres are available from the manufacture.)
- Level hold or one shot playback is possible.
- Binary and serial melody selection modes.
- Built-in DAC and crystal oscillator circuit.
- 3V power supply operation is possible.
- Stand-by mode.
- Low power consumption realized by silicon gate CMOS process.
- 16-pin plastic DIP (YMU277-D) or 16-pin plastic SOP (YMU277-M) .

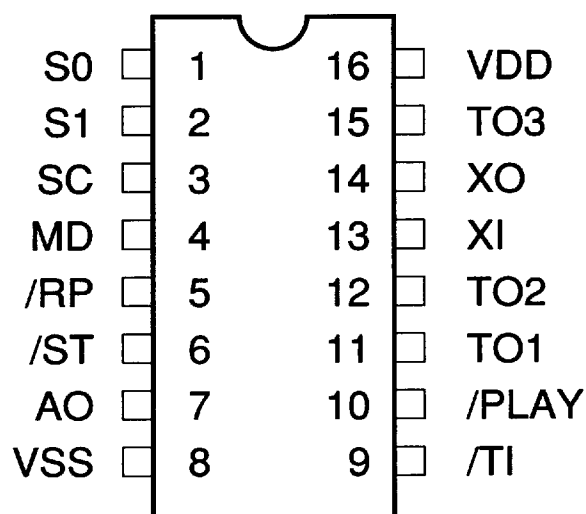
YAMAHA CORPORATION

■ 9945524 0002186 094 ■

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YMU277 CATALOG
CATALOG No. : -LSI4MU2773
1994. 11

## ■ PINOUT DIAGRAM



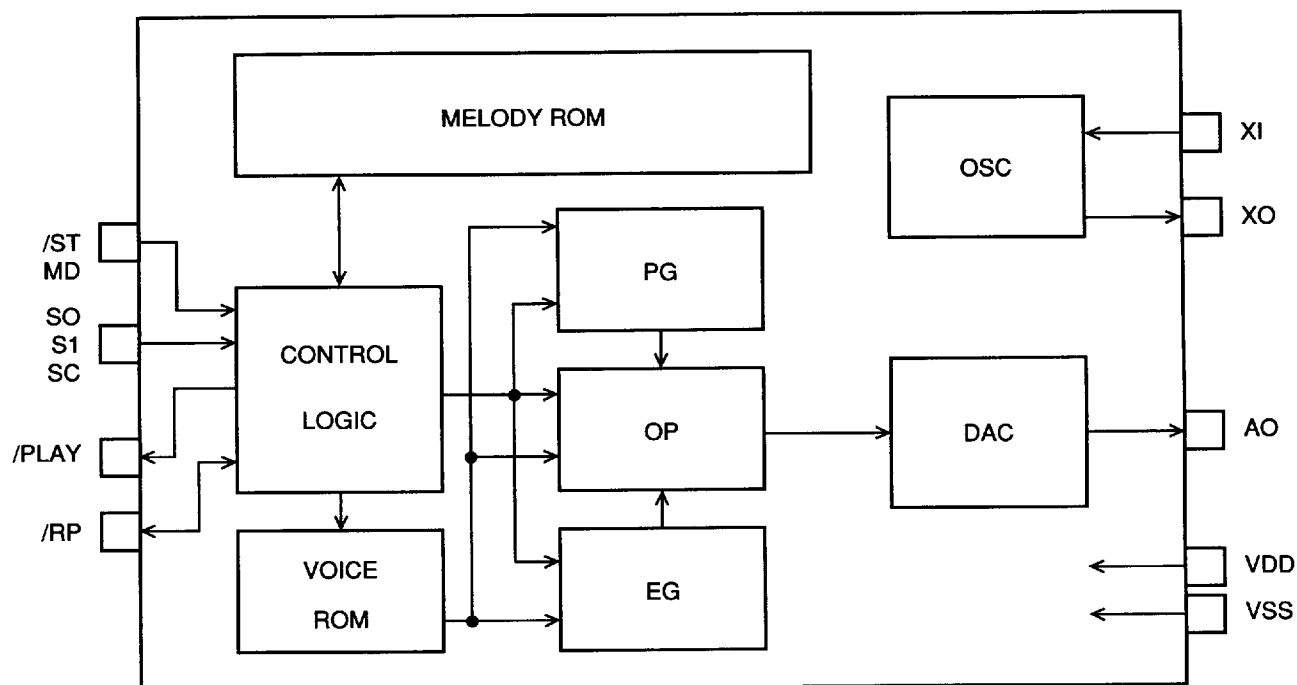
&lt;16Pin DIP Top View&gt;

## ■ PIN DESCRIPTION

No.	Name	I/O	Function
1	S0	I+	Input for melody (phrase) selection 0
2	S1	I+	Input for melody (phrase) selection 1
3	SC	I+	Selection of melody selection mode
4	MD	I+	Selection of performance mode
5	/RP	I+/O	Restart input, Melody number comparison output
6	/ST	I	Performance start
7	AO	O	Analog output
8	VSS	-	Ground
9	/TI	I+	Test terminal
10	/PLAY	O	Performance status output
11	TO1	O	Test terminal
12	TO2	O	Test terminal
13	XI	I	Crystal oscillation input (447.433kHz)
14	XO	O	Crystal oscillation output
15	TO3	O	Test terminal
16	VDD	-	Power supply

Note) I+ : Built-in pull-up resistance inputpin (disconnected during stand-by)

## ■ BLOCK DIAGRAM

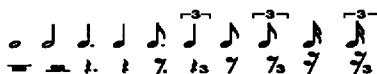
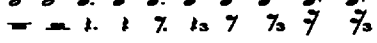


## ■ PLAY FUNCTION

### ● Sound source

Sound generation method : FM sound source by 2 operators.  
 No. of sound : Simultaneous generation of 4 sounds/4 timbres  
 Sound range : 3 octaves (C2<sup>#</sup> to C5)

### ● Melody control

Tempo range : Quarter note = 40~200  
 Note length :   
 Rest length :   
 Tie/Slur : Possible  
 No. of melodies : Maximum 4 melodies  
 No. of total steps : Maximum 255 steps (including notes, rests, JUMP and END commands)  
 Repeat function : It is possible to program any melody to be repeated.

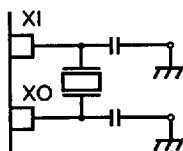
### ● Timber parameters

Multiple	: 1/2, 1, 2, 3, 4, 5, 6, 7	: 8 steps
Total level	: 0 to -47.25dB	: 64 steps
Feed back	: Self-feedback modulation	: 8 steps
Vibrate	: ON/OFF (Setting for each note is possible)	
EG type	: Continued/decay	
Attack rate	: 0.0ms to 38s	: 16 steps
Decay rate	: 4.5m to 73s	: 16 steps
Sustain level	: 0 to -45dB	: 16 steps
Release rate	: 4.5ms to 73s	: 16 steps
Sustain	: ON/OFF	

## ■ FUNCTION

### 1. CLOCK XI, XO

The clock oscillation frequency is selected from among 14.32MHz, 7.16MHz, 3.58MHz, and 447.5kHz by Metal Option. However, when an external crystal is used, only 447.5kHz. In this case, the oscillator is built by connecting a crystal or a ceramic oscillator and capacitor to the XI and XO terminals.



### 2. Analog output AO

The digital audio signal processed by the FM sound source is converted to an analog audio signal by an internal 9-bit DAC and is output from the AO terminal. The sampling frequency is 55.93kHz.

As a voltage is output from the AO terminal, buffer it with an operational Amplifier, etc. and use it through a lowpass filter.

### 3. Stand-by mode

Immediately after the power is turned on, after playing is stopped or ended, or when a specified time has elapsed, clock oscillation is stopped and the device enters the stand-by mode and the power consumption is reduced.

### 4. Play mode selection MD, /ST

When the MD pin input level is 'L', the device enters the level hold playback mode and when the MD pin input is 'H', the device enters the one-shot mode.

For a detailed description of operation of the /ST pin, see the "Playback start/stop/end and chatter" section.

#### · Level hold

When the /ST pin input level is 'L', playback is started and playing is repeated as long as the input level remains 'L'. When the /ST pin input is returned to 'H' level, playback is stopped (even if a melody is playing).

#### · One-shot

When the /ST pin input level is 'L', playback is started. Thereafter, playback is repeated the number of times specified in the device, even if the /ST pin input is returned to 'H' level. If the MD pin input level is made 'L' before the end of this repetitive playback, playback is stopped immediately (even if a melody is being played). At this time, the /ST pin must be returned to 'H' level.

### 5. Playback start/stop/end and chatter /ST, /PLAY

#### · Playback start

An /ST pin level change from 'H' to 'L' is received and the device enters the playback start wait state from the stand-by mode. Thereafter, level judgment is not performed for about 64ms to avoid erroneous operation by chatter. After this chatter countermeasure time has elapsed and the device has entered the level judgment state, if the level remains 'L', playback starts from the beginning of the specified melody or phrase. However, if the /ST pin returns to 'H' level, the device enters the stand-by mode from the playback start wait state and playback does not start.

· Playback stop

In the level hold playback mode, an /ST pin level change from 'L' to 'H' is received and the device enters the stop preparation state. If chatter is contained within 64ms and the /ST pin remains 'H' level, playback is stopped causing the device to enter the stand-by mode.

However, if the chatter is not contained within this time, the device enters the playback start wait stage.

· Playback end

In the one-shot playback mode, the device enters the stand-by mode approximately 64ms after playback has been repeated the specified number of times.

In this case, the device is controlled by the internal playback data and chatter does not have to be taken into account.

In the playback start wait state and in the stand-by mode, any internal circuit other than melody No. memory is placed in the initial state. If the /ST pin is at 'H' level when the power is turned on, the device changes from the unstable state to the stand-by mode.

The /play pin remains at 'L' level while a melody is playing.

## 6. Melody selection     /RP, SC, S0, S1

The melody selection mode is selected by /RP pin and SC pin input level.

A signal is statically given to the SC pin to control the melody selection function. The signal level is changed other than during playback. The serial melody selection functions when a negative polarity signal with the prescribed pulse width is input to the /RP pin during playback while the SC pin is at 'L' level. The /RP pin is placed in the output mode during playback while the SC pin is at 'H' level, and outputs a pulse signal with negative polarity when a melody No. different from the data of the melody No. memory in the device is input to melody selection pins S0 and S1. The signal is transferred into the device as a /RP pin signal to function for binary melody selection. When applying a 'H' level signal to the /RP pin in this state, it must not be directly connected to VDD but must be connected to VDD through a resistor. Each pin explained here is not provided with a chatter stopping circuit. The data in the melody No. memory in the device is memorized while the power is on. The data in the melody No. memory is not initialized when the power is turned on.

· Binary melody selection

The melody No. depends on the S0 and S1 pin level setting as shown below.

Melody No.	S1	S0
1	L	L
2	L	H
3	H	L
4	H	H

· Serial melody selection

The melody No. is sequentially increased one melody at a time by the melody selection operation. When the last melody No. is reached, melody selection shifts to the first melody No. However, the melody No. selected when the power is turned on is undefined. For serial melody selection, always set S0= 'H' , S1= 'L' .

## ■ Applications

### 1. Playback and melody selection functions and operation

R : Number of repetitions specified by score data

M : Melody No. (Sum of one added to melody selection value (binary))

S : Melody selection input (binary)

◆ : Switch held mechanically

▼ : Switch that remains ON while being pressed.

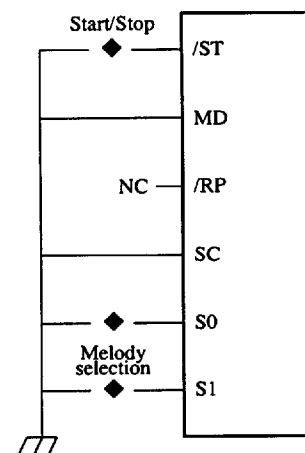
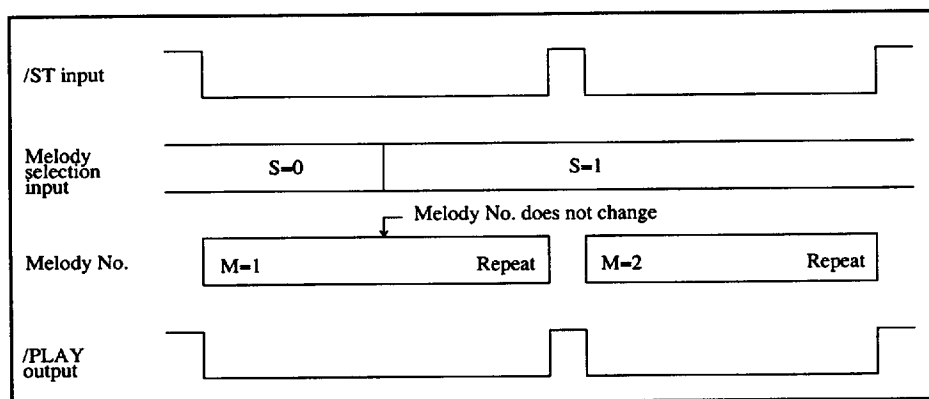
▼ : Switch that remains ON while being pressed.

Note: For the input pins which may be open in the stand-by mode other than while the input pin is fixed to VSS or VDD during operation (for example, MD, /RP, S0, and S1 which are connected through switches) and the NC (non-connected) pin, a 1M $\Omega$  resistor should be connected between each of such pins and VDD.

#### (1) Application 1

<Level hold mode, binary melody selection>

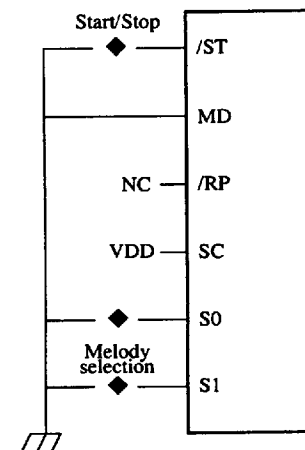
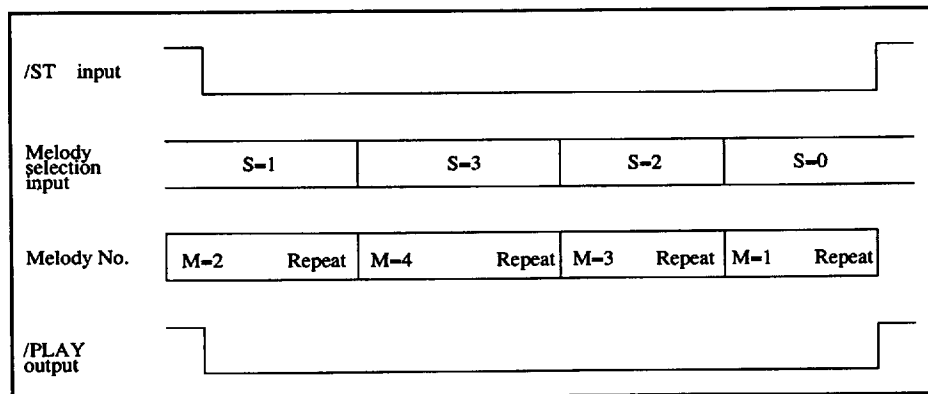
During playback, the melody number does not change even if a new melody number is selected.



#### (2) Application 2

<Level hold mode, binary melody selection>

When a new melody number is selected during playback, the melody number is changed and the new melody is played from the beginning.

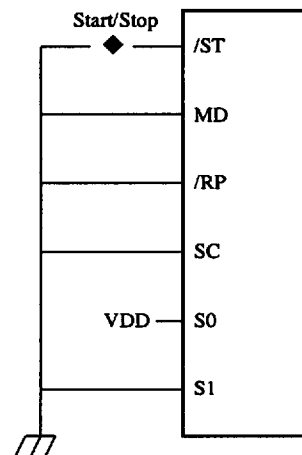
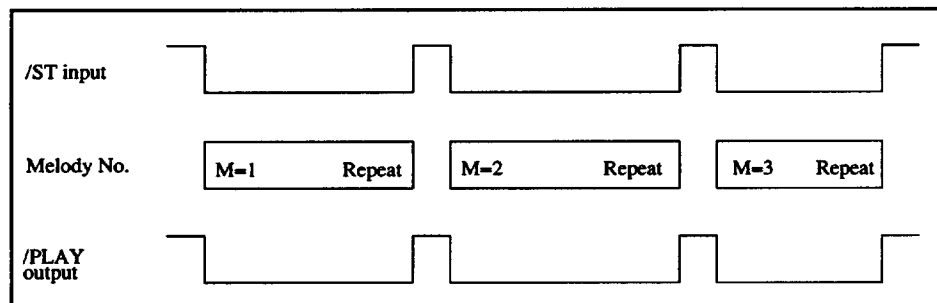


(3) **Application 3**

<Level hold mode, serial melody selection>

At starting, the melody number is sequentially increased one melody at a time.

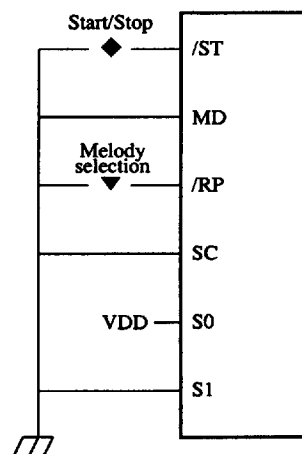
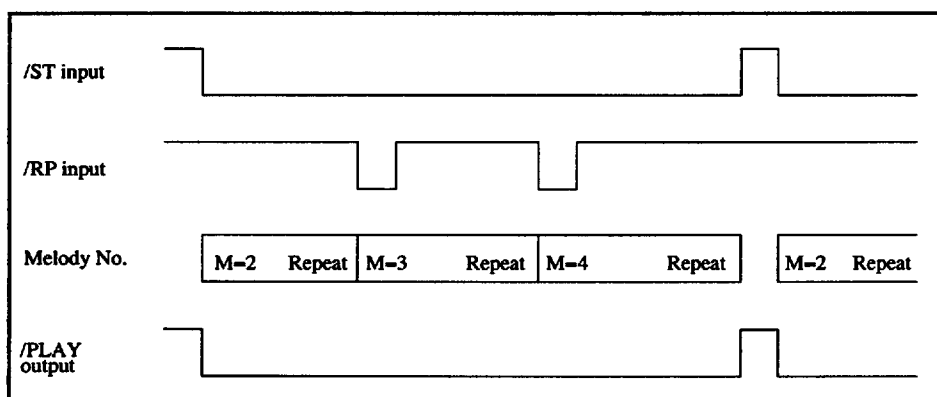
In the serial melody selection mode, always set S0= 'H' , S1= 'L' .

(4) **Application 4**

<Level hold mode, serial melody selection>

During playback, the melody number is sequentially increased one melody at a time by the falling edge of the /RP input.

In the serial melody selection mode, always set S0= 'H' , S1= 'L' .



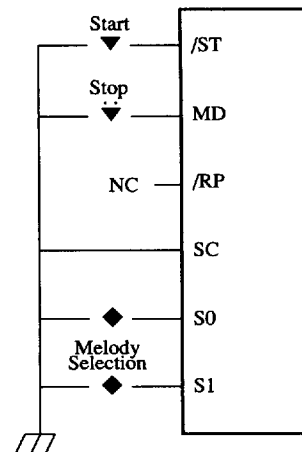
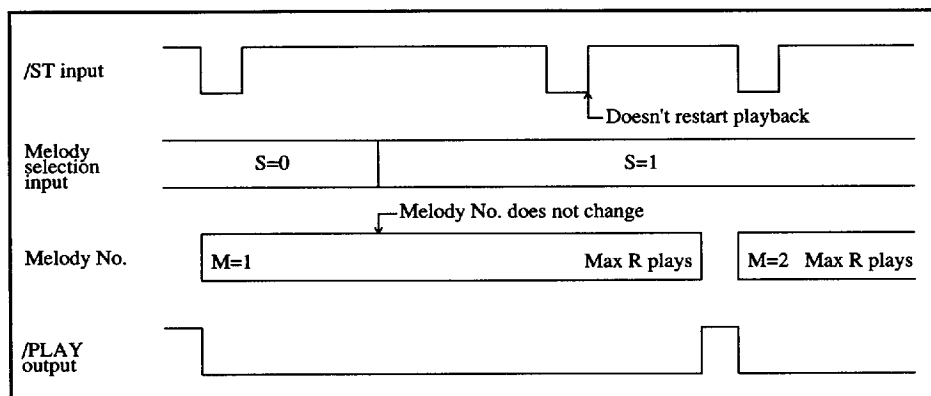


## (5) Application 5

< One-shot mode, binary melody selection >

During playback, the falling edge of the /ST input does not restart playback.

The melody number is changed by melody selection during playback.

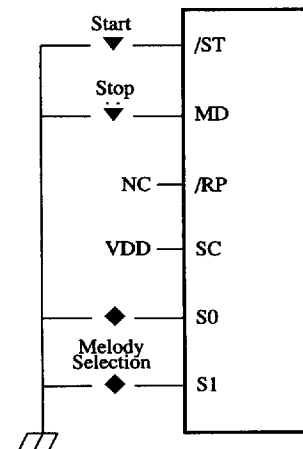
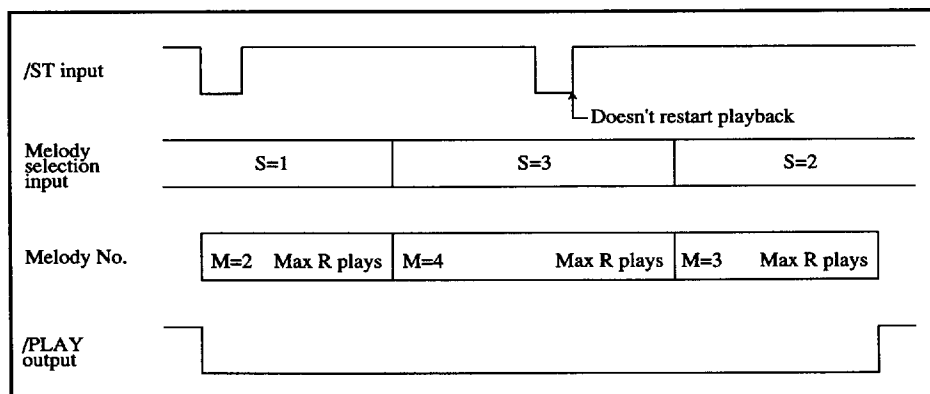


## (6) Application 6

< One-shot mode, binary melody selection >

During playback, the falling edge of the /ST input does not restart playback.

The melody No. is changed by melody selection during playback.

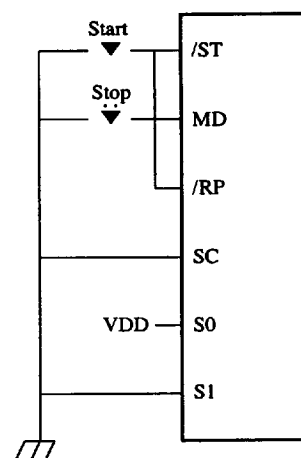
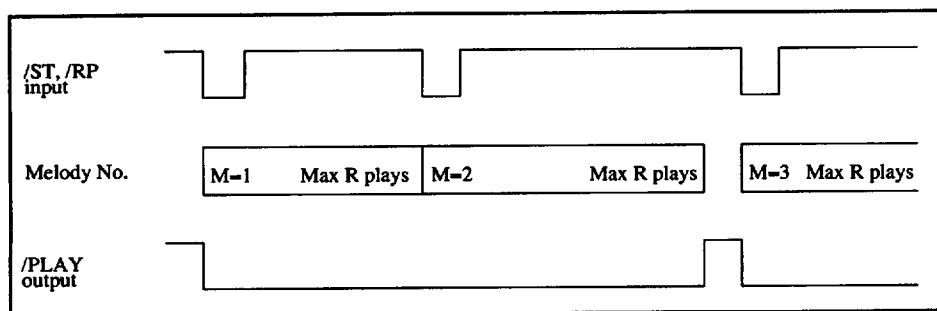


(7) Application 7

&lt; One-shot mode, serial melody selection &gt;

At starting, the melody number is sequentially increased one melody at a time.

In the serial melody selection mode, always set S0= 'H' , S1= 'L' .

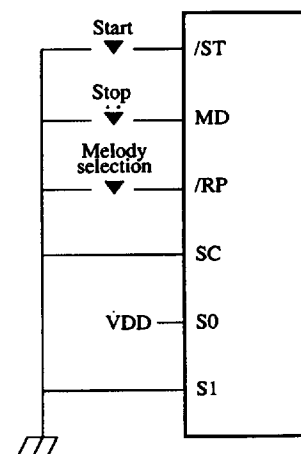
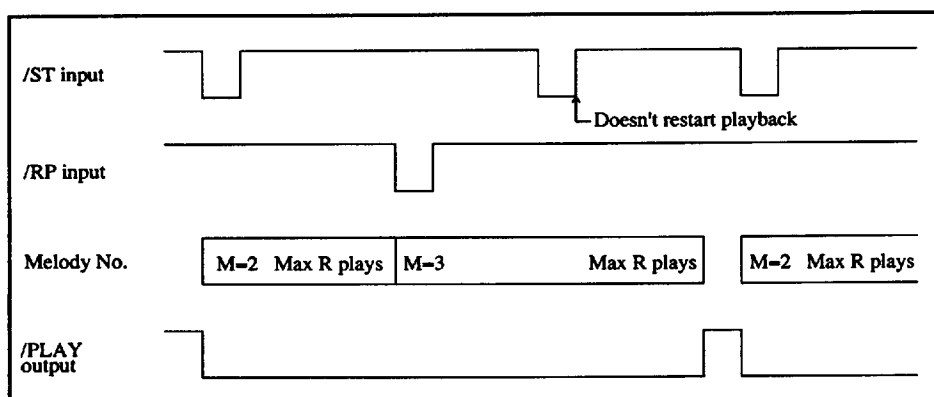
(8) Application 8

&lt; One-shot mode, serial melody selection &gt;

During playback, the falling edge of the /ST input does not restart playback.

During playback, the falling edge of the /RP input sequentially increases the melody number one melody at a time.

In the serial melody selection mode, always set S0= 'H' , S1= 'L' .



## ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V <sub>DD</sub>	-0.3 ~ 7.0	V
Operating temperature	Top	-20 ~ 85	°C
Storage temperature	Tstg	-50 ~ 125	°C

### Recommended operating conditions

Item	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V <sub>DD</sub>	2.4	3.0	5.25	V
	V <sub>SS</sub>	0	0	0	V

### DC characteristics (condition : Ta=0~70°C, V<sub>DD</sub>=2.4~5.25V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Current consumption	I <sub>DD1</sub>	V <sub>DD</sub> =5.0V			3.0	mA
	I <sub>DD2</sub>	V <sub>DD</sub> =3.0V			1.8	mA
	I <sub>DD3</sub>	V <sub>DD</sub> =2.4V			1.5	mA
Current consumption (Stand-by mode)	I <sub>DD4</sub>	V <sub>DD</sub> =5.0V *1			5.2	μA
	I <sub>DD5</sub>	V <sub>DD</sub> =3.0V *1			1.8	μA
	I <sub>DD6</sub>	V <sub>DD</sub> =2.4V *1			1.0	μA
Input voltage highlevel (1)	V <sub>IH1</sub>	*2	0.75V <sub>DD</sub>		V <sub>DD</sub> +0.5	V
Input voltage lowlevel (1)	V <sub>IL1</sub>	*2	-0.3		0.25V <sub>DD</sub>	V
Input voltage highlevel (2)	V <sub>IH2</sub>	*3	2.0		V <sub>DD</sub> +0.5	V
Input voltage lowlevel (2)	V <sub>IL2</sub>	*3	-0.3		0.4	V
Input current (1)	I <sub>I1</sub>	V <sub>I</sub> =0V *2	0.5		15	μA
Input current (2)	I <sub>I2</sub>	V <sub>I</sub> =0V *3	30		100	μA
Output voltage highlevel	V <sub>OH</sub>	I <sub>OH</sub> =0.2mA *4	0.8V <sub>DD</sub>		V <sub>DD</sub> +0.5	V
Output voltage lowlevel	V <sub>OL</sub>	I <sub>OL</sub> =1.0mA *4	0		0.5	V

Note) \*1 : When input voltage of XI, /ST, /RP, MD, SC, S0, S1, and /TI pin is high level.

\*2 : Applied to XI pin.

\*3 : Applied to /ST, MD, /RP, SC, S0, S1, and /TI pin.

\*4 : Applied to /RP, /PLAY, TO1, TO2, and TO3pin. However /RP pin isn't applied "I<sub>OH</sub>=0.2mA" .

### Analog characteristics (condition : Ta=0~70°C, V<sub>DD</sub>=2.4~5.25V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Analog output level	V <sub>OA</sub>	*1	0.63V <sub>DD</sub>		V <sub>DD</sub>	V

Note) \*1 : Applied to AO pin.

● Input/output capacity characteristics (condition :  $V_{DD}=5V$ ,  $F=1MHz$ ,  $T_a=25^{\circ}C$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Input pin capacity	C <sub>i</sub>	$V_i=V_{SS}$			10	pF
Output pin capacity	C <sub>o</sub>	$V_o=V_{SS}$			10	pF

● AC characteristics (condition :  $T_a=0\sim70^{\circ}C$ ,  $V_{DD}=2.4\sim5.25V$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock frequency	fx1		435000	447443	460000	Hz
Prescale : 0				3.5795		MHz
Prescale : 1				7.1590		MHz
Prescale : 2				14.318		MHz
Prescale : 3						
Duty	D		40	50	60	%
MD setup time from /ST fall	t <sub>MS</sub>		0			ms
MD hold time from /ST rise	t <sub>MH</sub>		0			ms
/ST chatter stop time	t <sub>STX</sub>	*2		32768		*1 CLOCK
/ST pulse width	t <sub>STW</sub>	*3	t <sub>STX</sub> +1			CLOCK
/ST setup time from MD fall	t <sub>SMS</sub>	*3	2			CLOCK
/ST setup time from /PLAY rise	t <sub>SPS</sub>	*3	t <sub>EP</sub> +2			CLOCK
Sn setup time from /ST rise and /RP fall	t <sub>SS</sub>		0			CLOCK
Sn hold time from /ST fall and /RP fall	t <sub>SH</sub>		32781			CLOCK
/PLAY fall delay time from /ST fall	t <sub>SP</sub>				32768	CLOCK
/PLAY rise delay time from /ST rise	t <sub>STP</sub>	*4			32771	CLOCK
/PLAY rise delay time from MD fall	t <sub>MP</sub>	*3	4		32771	CLOCK
/PLAY rise delay time from END	t <sub>EP</sub>	*3			32771	CLOCK
/RP pulse width	t <sub>RP</sub>		16			CLOCK
Sn Recovery time	t <sub>RS</sub>		32781			CLOCK
/RP Recovery time	t <sub>RR</sub>		32781			CLOCK

Note) Clock oscillation is stopped till /ST trigger input ; therefore each timing are needed time till oscillation rise.

\*1 : CLOCK of Unit column is time prescale [0] .

Prescale is selected by Metal Option.

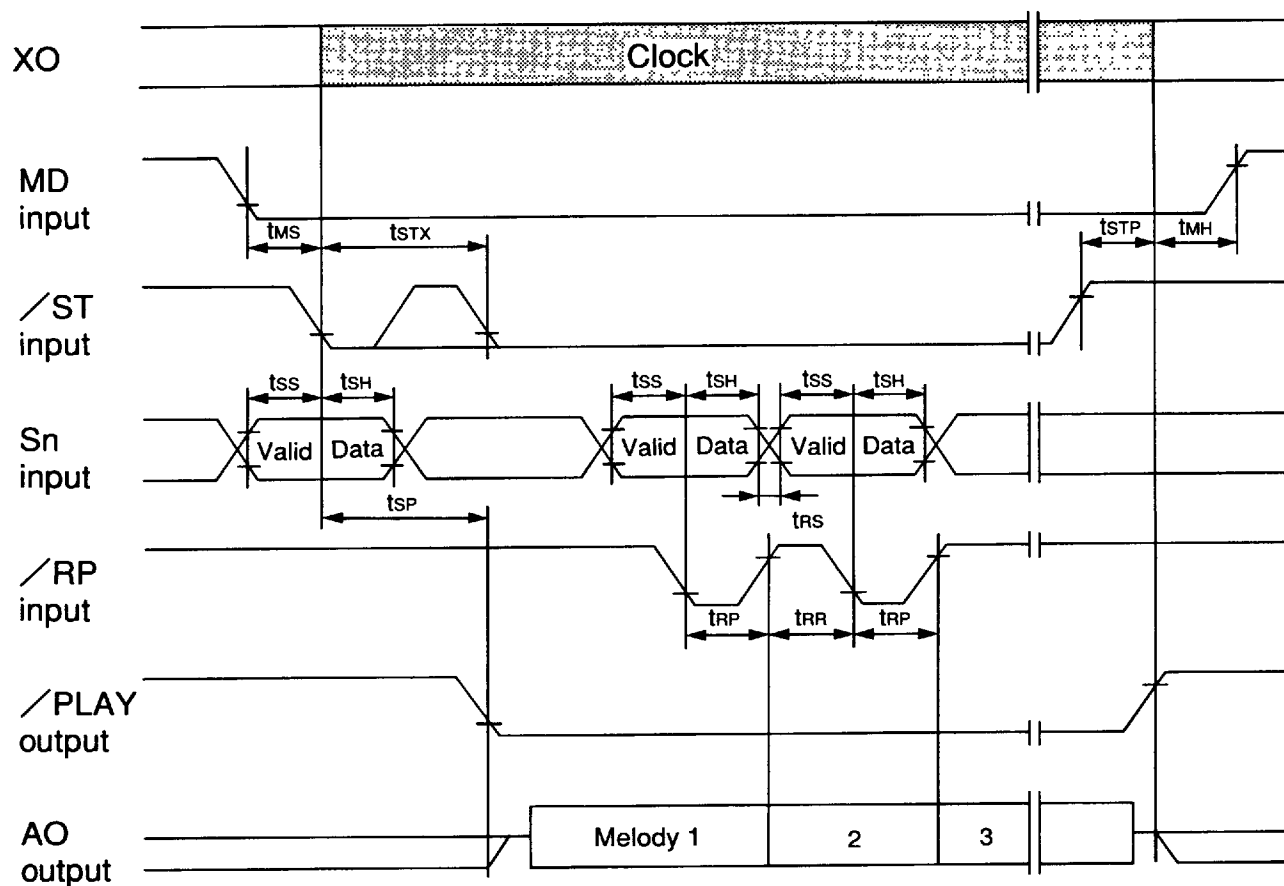
\*2 : Level of /ST pin isn't judged while timing "t<sub>STX</sub>" after /ST became "L" .

\*3 : Applied to One-shot mode (MD= "H") .

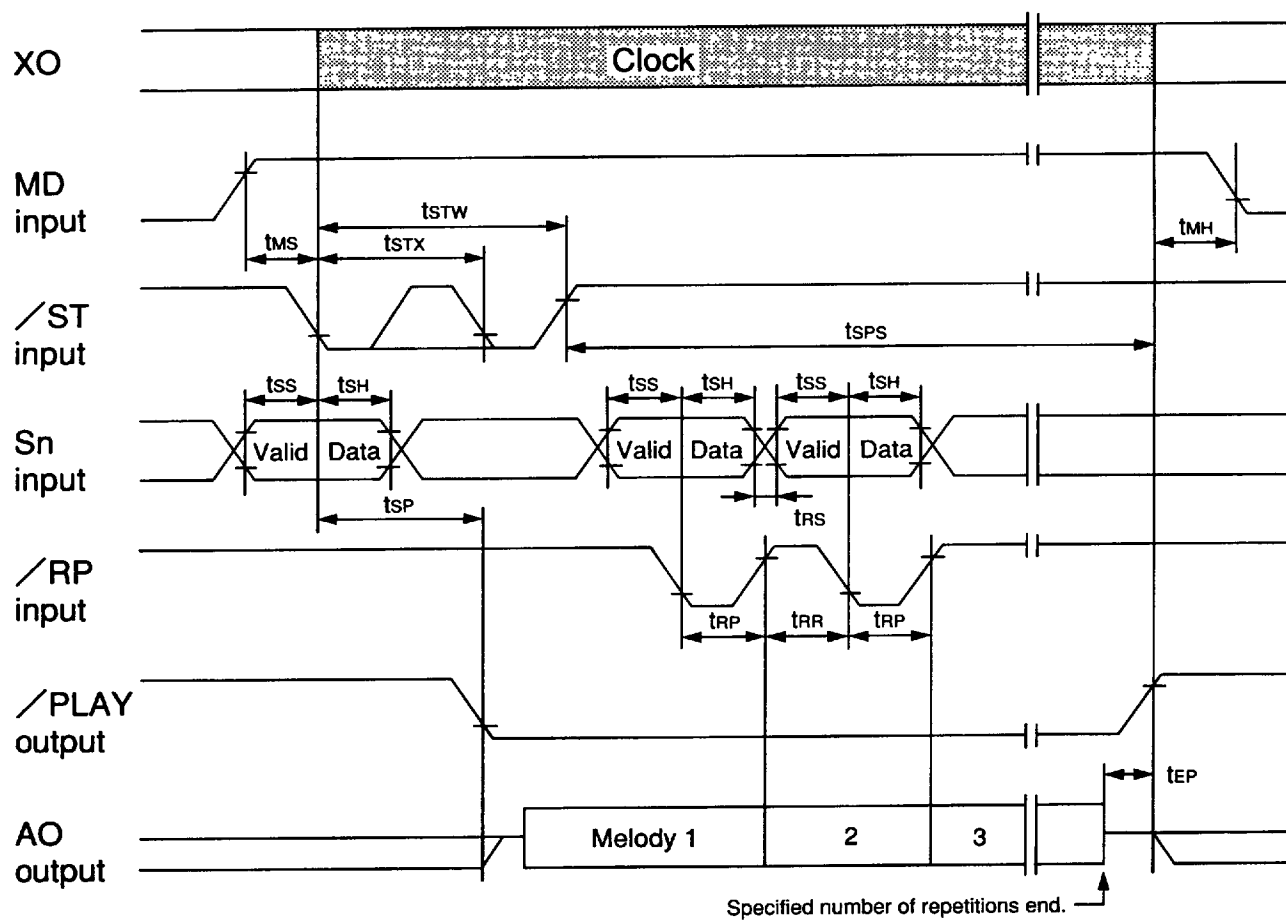
\*4 : Applied to Level hold mode (MD= 'L') .

## ● Timing chart

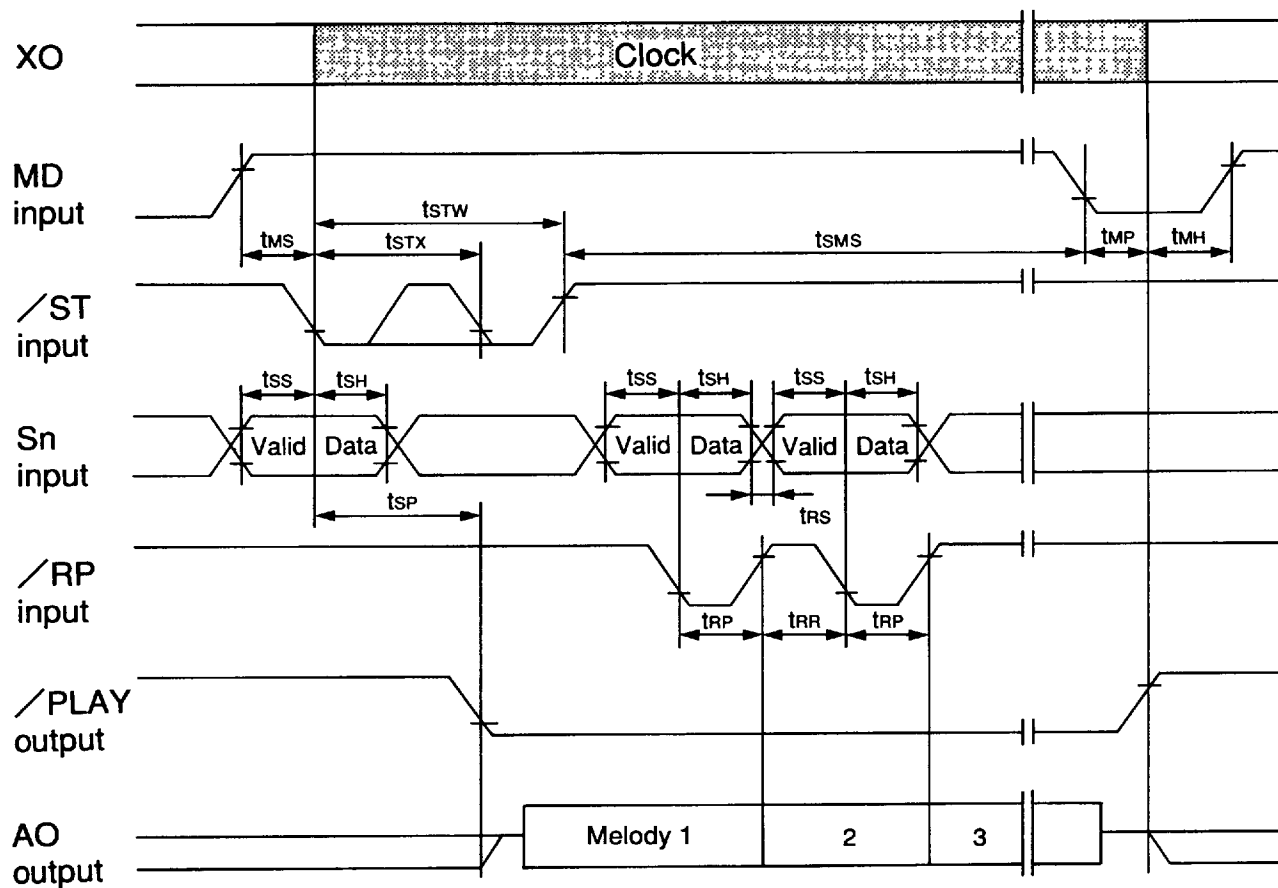
(1) Level hold mode



## (2) One-shot mode

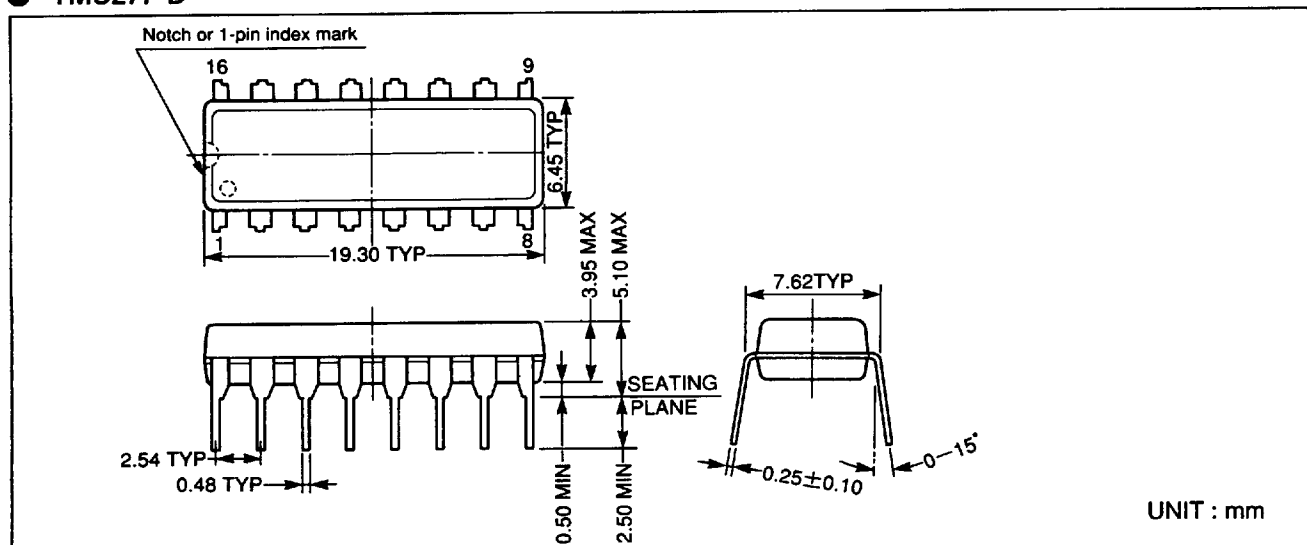


(3) One-shot mode (When stop the playback by force before specified number of repetitions end.)

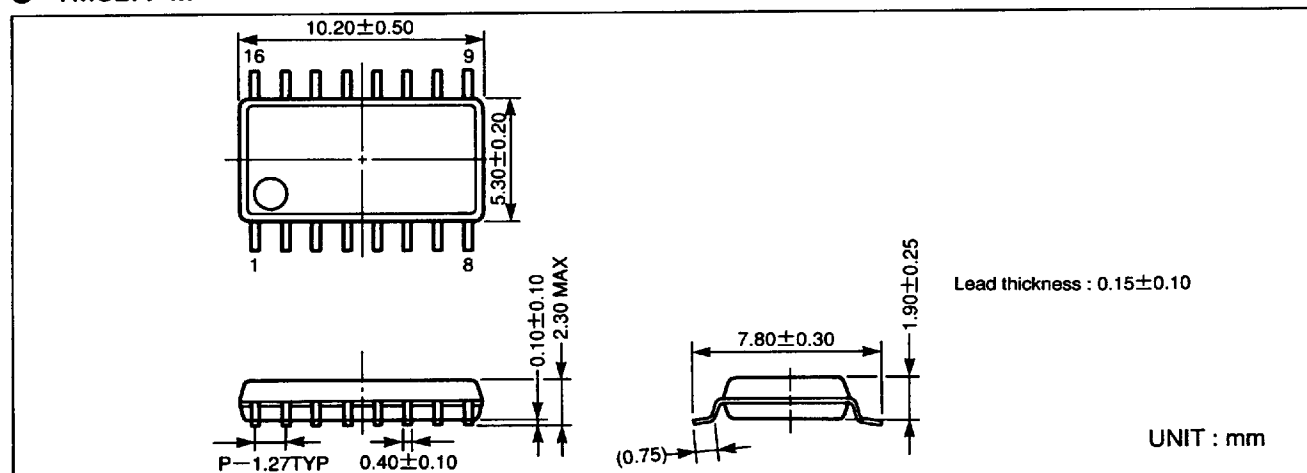


## ■ EXTERNAL DIMENSIONS

## ● YMU277-D



## ● YMU277-M



The specifications of this product are subject to improvement changes without prior notice.

AGENCY

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