

■ OVERVIEW

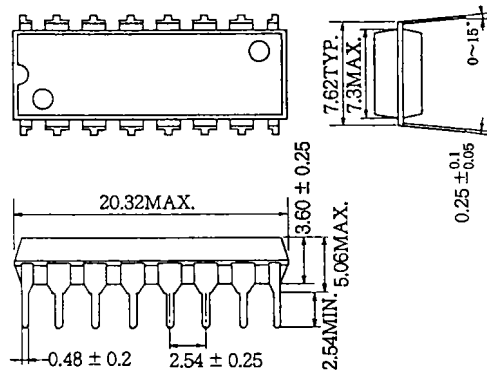
The SM1400AP is a C-MOS LSI for the guitar tuner for tuning an electric guitar, acoustic guitar and other kinds of guitars.

■ FEATURES

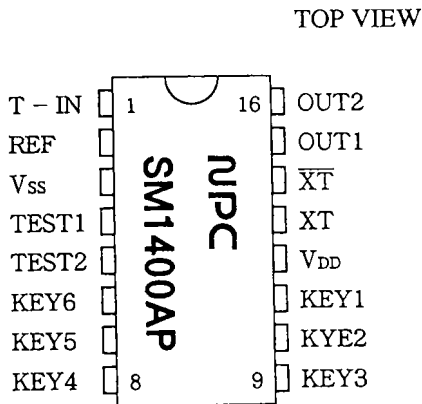
- On-chip capacitor for crystal oscillation
- 440Hz reference tone output
- On-chip Pull-down resistance at each input terminal
- Minimal external parts
- The display of the deviation from reference
- Guitar of 6 strings can be tuned
- 16-PIN plastic DIP

■ PACKAGE DIMENSION

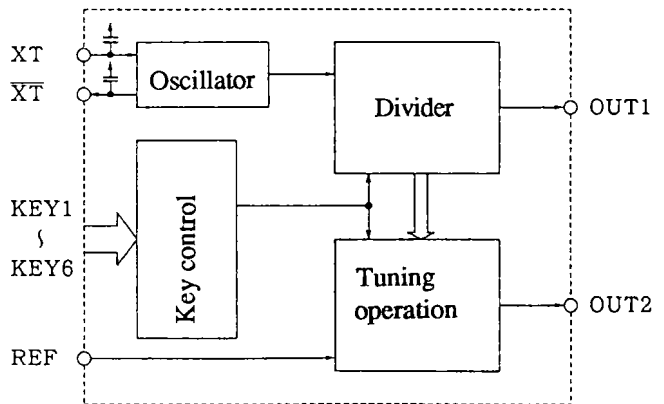
(UNIT: mm)



■ PIN OUT



■ BLOCK DIAGRAM



■ PIN DESCRIPTION

PIN#	NAME	DESCRIPTION	PIN#	NAME	DESCRIPTION
1	T-IN	Input terminal for tone tuned.	6 to 11	KEY6 to KEY1	Tone code input terminals On-chip pull-down resistance
2	REF	Generate the reference tone when REF is V <sub>DD</sub> level on-chip pull-down resistance.	12	V <sub>DD</sub>	Power-supply +5V
			13	XT	To connect crystal (4.25216MHz)
3	V <sub>SS</sub>	Ground	14	XT	On-chip capacitor for oscillation
4	TEST1	Testing terminals. Normally "Open"	15	OUT1	Output of reference tone
5	TEST2		16	OUT2	Signal output for meter display

■ ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	LIMIT	UNIT
Supply Voltage	V <sub>DD</sub> -V <sub>SS</sub>	-0.3 to +70	V
Input Voltage	V <sub>IN</sub>	V <sub>SS</sub> ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>	V
Operating temperature	T <sub>OPR</sub>	-20 to +60	°C
Storage temperature	T <sub>STG</sub>	-55 to +125	°C
Soldering temperature	T <sub>SLD</sub>	260±5	°C
Soldering time	t <sub>SLD</sub>	10.5±0.5	Sec

■ ELECTRICAL CHARACTERISTICS

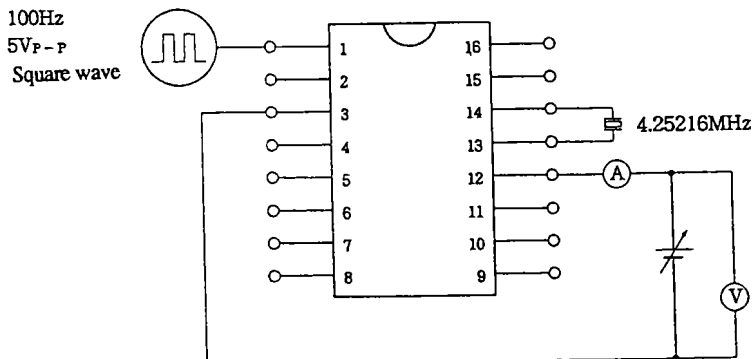
(T<sub>a</sub>=25°C, V<sub>SS</sub>=0V, V<sub>DD</sub>=5V  
f<sub>0</sub>=4.25216MHz unless otherwise noted)

ITEM	SYMBOL	CONDITION	LIMIT			UNIT	NOTE
			MIN	TYP	MAX		
Operating voltage	V <sub>DD</sub>		4.5	5.0	5.5	V	
Current consumption	I <sub>DD</sub>	Fig. 1		2	5	mA	When reference tone is out.
Input voltage	V <sub>IH</sub>		V <sub>DD</sub> -0.4			V	T-IN, KEY1 to 6, REF
	V <sub>IL</sub>				0.4		
Input current	I <sub>IH</sub>	V <sub>IH</sub> =5.0V	50		500	μA	KEY1 to 6, REF
	I <sub>IL</sub>	V <sub>IL</sub> =0.0V			0.1		
Output current	I <sub>OH</sub>	V <sub>OH</sub> =4.5V	1.0			mA	OUT1, OUT2
	I <sub>OL</sub>	V <sub>OL</sub> =0.5V	1.0				
Oscillation start time	T <sub>ON</sub>	for 5 correct PULSE			1	sec	
Oscillation start voltage	V <sub>DOB</sub>				4.5	V	
Frequency stability f vs V <sub>DD</sub>	ε <sub>1</sub> , ε <sub>2</sub>	Δ V <sub>DD</sub> =0.1V			20	ppm	note 1
Frequency deviation	e'				100	ppm	note 2

Note 1)  $\epsilon_1 = |f(4.5V) - f(5.0V)| / f_0 \times 5$ ,  $\epsilon_2 = |f(5.5V) - f(5.0V)| / f_0 \times 5$

Note 2)  $e' = |f(5.0V) - f_0|$

Fig. 1



## ■ TUNING SCALE FUNCTION

Open string scale of guitar and base is tuned by setting the KEY1 to KEY6 as follows:

**Scale Selection table**

1 =  $V_{DD}$ , 0 =  $V_{SS}$  or OPEN

KEY1	KEY2	KEY3	KEY4	KEY5	KEY6	Base guitar	* guitar
0	0	0	0	0	1	41.2Hz • 4E	82.4Hz • 6E
0	0	0	0	1	0	55.0Hz • 5A	110.0Hz • 5A
0	0	0	1	0	0	73.4Hz • 2D	146.8Hz • 4D
0	0	1	0	0	0	98.0Hz • 1G	196.0Hz • 3G
0	1	0	0	0	0	—	246.9Hz • 2B
1	0	0	0	0	0	—	329.6Hz • 1E

\* Electric guitar &  
Acoustic guitar

## ■ REFERENCE TONE OUTPUT FUNCTION


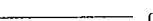

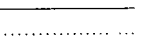
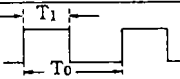
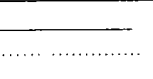


Reference tone is output while REF is  $V_{DD}$  which is selected by KEY1 to KEY6 as shown in table below. When reference tone is being output, tuning is not available.

1 =  $V_{DD}$ , 0 =  $V_{SS}$  or OPEN

KEY1	KEY2	KEY3	KEY4	KEY5	KEY6	Reference frequency
0	0	0	0	0	1	438 [Hz]
0	0	0	0	1	0	439
0	0	0	1	0	0	440
0	0	1	0	0	0	441
0	1	0	0	0	0	442
1	0	0	0	0	0	443

## ■ SIGNAL OUTPUT FOR METER DISPLAY FUNCTION

Input signal from T-IN terminal is compared with tone selected by KEY1 to KEY6, then deviation signal is output from OUT2 as follows.

Deviation	OUT2 output signal		
	Pulse duty	Output waveform	Level after output rectification
Without -104 to +256.25 cent	0		
Within -103.75 to -51 cent	$\frac{13}{128}$		
Within -50.75 to +64 cent	$\frac{13}{128}$ to 1		
Within +64.25 to +256 cent	1		

■ APPLICATION CIRCUIT (EXAMPLE)

