■ OVERVIEW

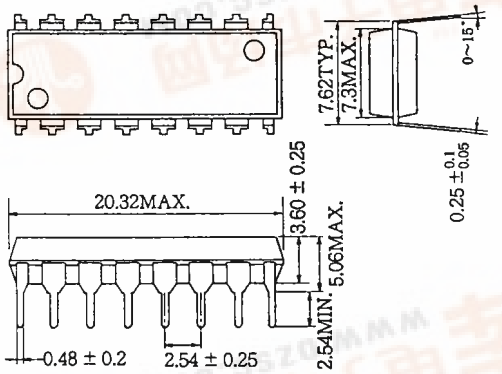
The SM1400AP is a C-MOS LSI for the guitar tuner for tunning an electric guitar, acoustic guitar and other kinds of guitars.

■ 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

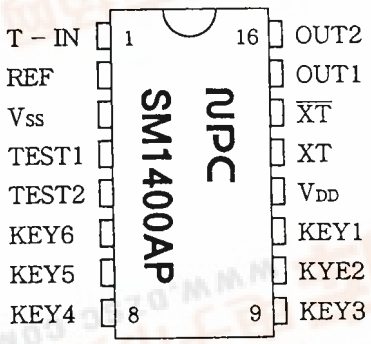
■ PACKAGE DIMENSION

(UNIT: mm)

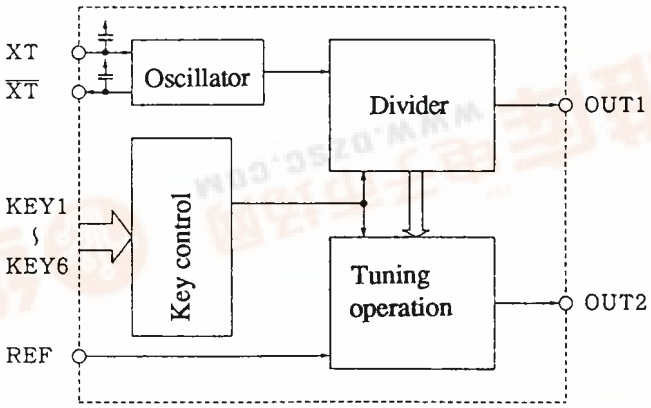


■ PIN OUT

TOP VIEW



■ BLOCK DIAGRAM



■ PIN DESCRIPTION

PIN#	NAME	DESCRIPTION	PIN#	NAME	DESCRIPTION
1	T-IN	Input terminal for tone tuned.	6 to11	KEY6 to KEY1	Tone code input terminals On-chip pull-down resistance
2	REF	Generate the reference tone when REF is V_{DD} level on-chip pull-down resistance.	12	V_{DD}	Power-supply +5V
			13	XT	To connect crystal (4.25216MHz)
3	V_{SS}	Ground	14	$\overline{XT}$	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_{DD}-V_{SS}	-0.3 to +70	V
Input Voltage	V_{IN}	$V_{SS} \leq V_{IN} \leq V_{DD}$	V
Operating temperature	T_{OPR}	-20 to +60	°C
Storage temperature	T_{STG}	-55 to +125	°C
Soldering temperature	T_{SLD}	260±5	°C
Soldering time	t_{SLD}	10.5±0.5	Sec

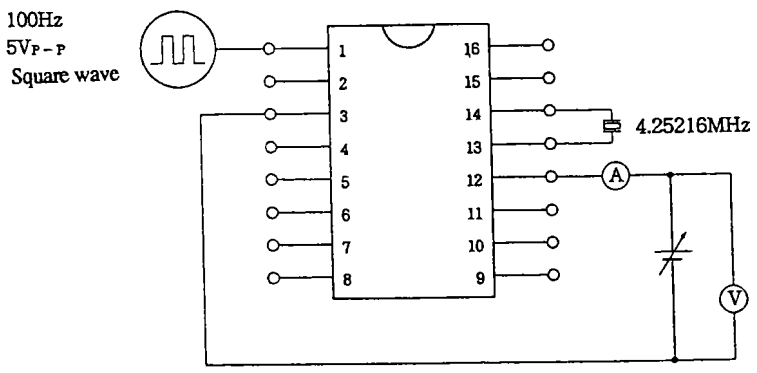
■ ELECTRICAL CHARACTERISTICS

(Ta=25°C, V_{SS}=0V, V_{DD}=5V
f_o=4.25216MHz unless otherwise noted)

ITEM	SYMBOL	CONDITION	LIMIT			UNIT	NOTE
			MIN	TYP	MIN		
Operating voltage	V_{DD}		4.5	5.0	5.5	V	
Current consumption	I_{DD}	Fig. 1		2	5	mA	When reference tone is out.
Input voltage	V_{IH}		V_{DD}-0.4			V	T-IN, KEY1 to 6, REF
	V_{IL}				0.4		
Input current	I_{IH}	V_{IH}=5.0V	50		500	μA	KEY1 to 6, REF
	I_{IL}	V_{IL}=0.0V			0.1		
Output current	I_{OH}	V_{OH}=4.5V	1.0			mA	OUT1, OUT2
	I_{OL}	V_{OL}=0.5V	1.0				
Osillation start time	T_{ON}	for 5 correct PULSE			1	sec	
Osillation start voltage	V_{DOB}				4.5	V	
Frequency stability f vs V_{DD}	ε_1,ε_2	Δ V_{DD}=0.1V			20	ppm	note 1
Frequency deviation	ε'				100	ppm	note 2

Note 1) $\varepsilon 1 = |(f(4.5V) - f(5.0V)) / fo| \div 5$, $\varepsilon 2 = |(f(5.5V) - f(5.0V)) / fo| \div 5$ Note 2) $\varepsilon' = |(f(5.0V) - fo)|$

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

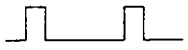
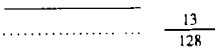
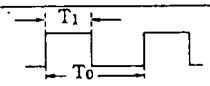
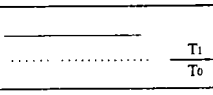
Reference tone is output while REF is V_{DD} which is selected by KEY1 to KEY6 as shown in table below. When reference tone is being output, tuning is not available.

$1 = V_{DD}$, $0 = V_{SS}$ 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		0
Within -103.75 to -51 cent	$\frac{13}{128}$		 $\frac{13}{128}$
Within -50.75 to +64 cent	$\frac{13}{128}$ to 1	 T_1 T_0	 $\frac{T_1}{T_0}$
Within +64.25 to +256 cent	1		1

■ APPLICATION CIRCUIT (EXAMPLE)