H 1344

CMOS Circuit for Analog Quartz Clocks with Bipolar Stepping Motor Drive

Features

- 32kHz quartz oscillator
- Integrated capacitors, mask selectable
- Single battery operation
- 0.7μA typical current consumption
- Low resistance outputs for bipolar stepping motor
- Mask options for pad designation, motor period and pulse width, alarm frequency, modulation and duty cycle
- Alarm output function compatible with either NPN or PNP-driver transistors
- Alarm input function
- 1024Hz output on AL_{IN} pad for oscillator frequency verification
- Fast test function
- ESD protected terminals

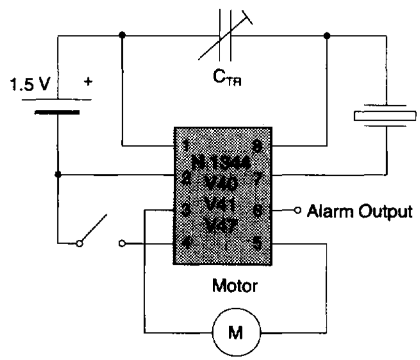
Description

The H 1344 is a low power 32kHz analog clock integrated circuit designed in HCMOS technology to drive a bipolar stepping motor. A set of capacitors is provided on chip to be connected, in any combination, to the two oscillator terminals, with a maximum total capacitance of 48pF. Both the motor pulse period and the motor pulse width are mask-programmable. **See Table 5 for already available options.**

Application

- Analog clocks

Functional Diagram



Operating range of trimmer
Capacitance: 1.5pF ≤ C_{TR} ≤ 30 pF

Fig. 1

Pin Assignment

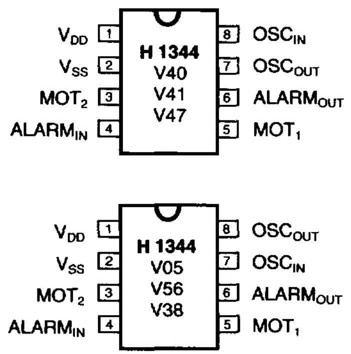


Fig. 2

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Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Supply voltage range	V_{DD} - V_{SS}	−0.3	+5	V
Input voltage	V_{IN}	V_{SS}	V_{DD}	V
Storage temperature	T_{STOR}	−55	+125	°C

Table 1

Stresses beyond these listed maximum ratings may cause permanent damage to the device. Exposure to conditions beyond specified operating conditions may affect device reliability or cause malfunction.

Handling Procedures

This device contains circuitry to protect the terminals against damage due to high static voltages or electrical fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this circuit.

Recommended Operating Conditions

Parameter	Symbol	Value	Units
Ambient temperature	T	25	°C
Quartz frequency	f_Q	32768	Hz
Quartz series resistance	R_Q	30	kΩ
Motor coil resistance	R_M	200	Ω
Positive supply	V_{DD}	1.55	V
Negative supply	V_{SS}	0	V

Table 2

Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating temperature	T_{OPR}	−20		+70	°C
Quartz series resistance			30	50	kΩ
Trimmer capacitance	C_{TR}	1.5		30	pF

Table 3

Electrical and Switching Characteristics

at recommended operating conditions (valid unless otherwise specified)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply voltage	V_{DD}	operating	+1.1		+1.8	V
Supply current	I_{DD}	without motor, AL_{IN} open		0.7	2.0	μA
Motor Output						
Current into load	I_M	$V_{DD} = 1.2V$, $R_M = 200\Omega$	±4.0			mA
Pulse period	T_1			Mask option*		s
Pulse width	t_W			Mask option*		ms
Alarm Output						
Frequency	f_A			Mask option*		Hz
Modulation	f_{A1}			Mask option*		Hz
Cycle time	t_2			Mask option*		s
Pulse duration	t_P			Mask option*		s
Output current for	I_{ALOUTN}	$V_{DD} = 1.2V$, $V_{OL} = 0.2V$	0.5			μA
driving NPN-transistor	I_{ALOUTP}	$V_{DD} = 1.2V$, $V_{OH} = 0.7V$	0.3			mA
Output current for	I_{ALOUTN}	$V_{DD} = 1.2V$, $V_{OL} = 0.5V$	0.3			mA
driving PNP-transistor	I_{ALOUTP}	$V_{DD} = 1.2V$, $V_{OH} = 1.0V$	0.5			μA
Alarm Input Test In/Output						
Alarm input delay	t_{ALD}		125		570	ms
Test frequency	f_T			1024		Hz
Input current (alarm)	I_{IN}	Input at V_{SS}, $V_{DD} = 1.4V$	−1	−5	−10	μA
Input current	I_{IN}	Input at V_{DD}	1	15	30	μA
Oscillator						
Build-up time	t_{START}	$V_{DD} = 1.2V$			2	s
Stability against supply voltage variations	$\frac{\Delta f}{\Delta V_{DD} \times f}$	$1.1V \leq V_{DD} \leq 1.8V$		5	12	ppm/V
Output capacitance	C_{OUT}			Mask option*		pF
Input capacitance	C_{IN}			Mask option*		pF

* : See "Available options" on page 6.

Table 4

Timing Waveforms

Motor Output Waveform

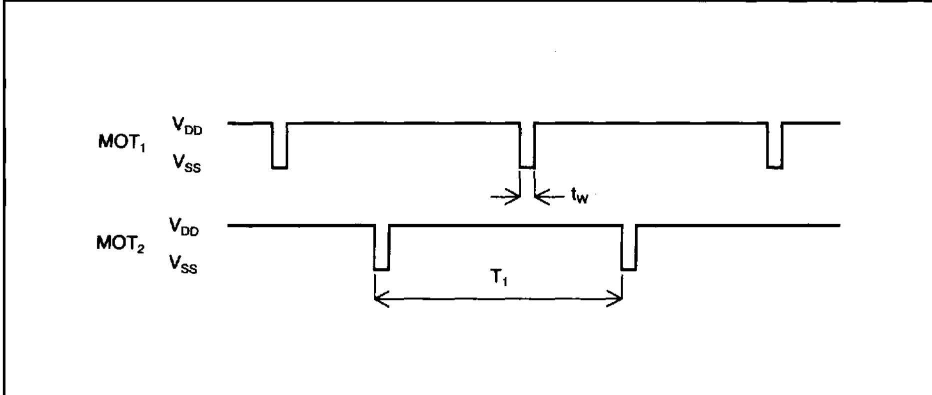


Fig. 3

Alarm Output Waveform

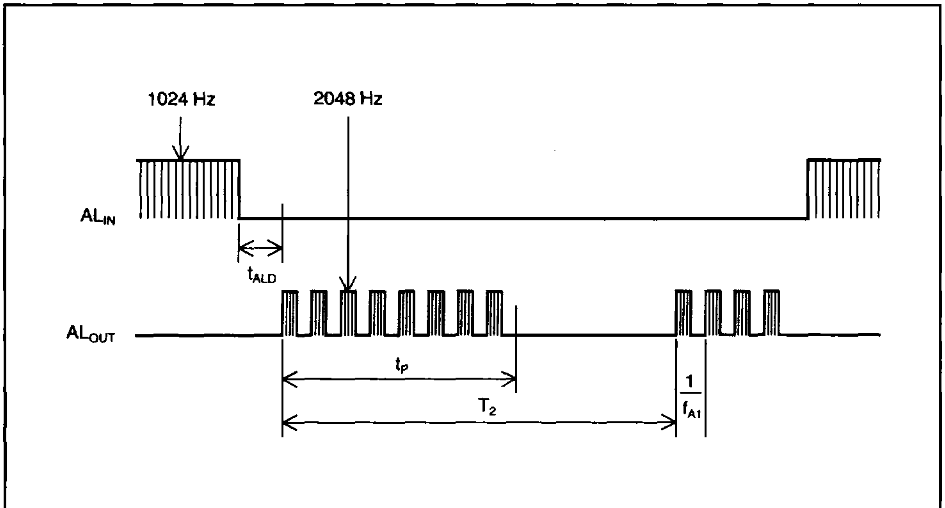


Fig. 4

Functional Description

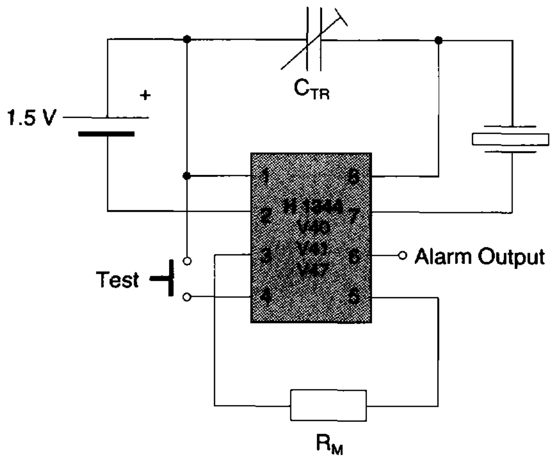
Oscillator and Frequency Divider
The quartz oscillator consists of an inverter, internal feedback resistor to bias the input, series output resistance to improve stability and integrated capacitors. The values of the integrated capacitors are selectable by metal mask. The oscillator is designed for 32768Hz.

Motor Drive Output
The circuit contains two push-pull output buffers for driving bipolar stepping motors. Between two pulses, both P-channel transistors conduct. During an output pulse, the N-channel transistor of one buffer and the P-channel transistor of the other buffer are conducting. The outputs are protected against inductive voltage spikes with diodes to both supply pins.
Both the motor pulse period and motor pulse width are programmable by metal mask over a wide range of values (see Table 5 for available options).

Alarm Output
The alarm is activated by connecting $ALARM_{IN}$ to V_{SS} and is deactivated by opening the connection. A metal mask option is available to program a continuous activation of the alarm output.
The alarm output driver contains a push-pull output buffer to drive an external sound source by means of an external bipolar transistor. A metal mask option is available to allow the use of NPN or PNP-transistors.
The tone frequency, modulation frequency and cycle time (ON/OFF time) are metal mask selectable.

Test Mode
The $ALARM_{IN}$ pin fulfills three functions:
a) For normal operation, the $ALARM_{IN}$ pin is left open. The circuit provides a square wave signal of 1024Hz, which can be used to tune the oscillator.
b) If the pin is connected to V_{SS}, the alarm signal is provided at pin 6.
c) If the $ALARM_{IN}$ pin is connected to V_{DD}, all output frequencies are increased by a factor of 64, the alarm modulations of f_{A1} = 8Hz and f_A = 2kHz are suppressed.

Test configuration

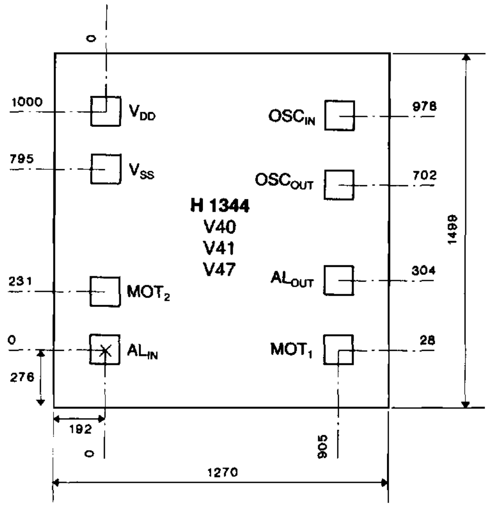


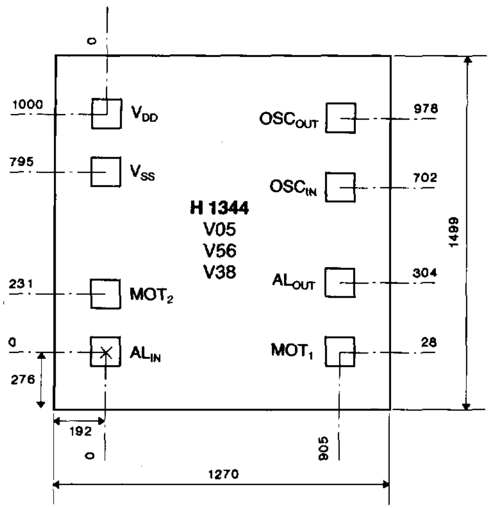
Operating range of trimmer
Capacitance: 1.5 pF ≤ C_{TR} ≤ 30 pF

Fig. 5

Pad Location Diagram

All dimensions in µm





Chip size: 1270 x 1499 microns
50 x 59 mils

Fig. 6

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Available Options

Option	Motor		Alarm Output				Integrated Capacitance		Alarm Output Transistor
	Period (T_1)	Pulse width (t_W)	Frequency (f_A)	Modulation (f_{A1})	Cycle Time (T_2)	Pulse Duration (t_P)	(C_{IN})	(C_{OUT})	
V05*	2s	46.8ms	2048Hz	8Hz	4s	1s	16pF	23pF	NPN
V38	2s	46.8ms	2048Hz	8Hz	4s	1s	3pF	28pF	NPN
V40	2s	46.8ms	2048Hz	8Hz	4s	1s	3pF	20pF	NPN
V41	2s	23.4ms	2048Hz	8Hz	4s	1s	3pF	20pF	NPN
V47	2s	31.24ms	2048Hz	8Hz	1s	0.5s	3pF	20pF	NPN
V56*	2s	46.8ms	2048Hz	8Hz	4s	1s	19pF	23pF	NPN

* : Without external trimmer (quartz classes to be matched).

Table 5