Features

- **32-kHz Oscillator**
- **1.3 V to 1.8 V Operating-voltage Range**
- **180 nA Typical Current Consumption**
- **Voltage Regulator**
- **Integrated Capacitors, Mask Selectable**
- **Mask Options for Pad Designation, Motor Period and Motor Pulse Width**
- **Low Resistance Outputs for Bipolar Stepping Motor**
- **Motor Fast-test Function**

Description

The e1217X is an integrated circuit in CMOS silicon gate technology for analog watches. It consists of a 32-kHz oscillator, frequency dividers down to 1/64 Hz, output pulse formers and push-pull motor drivers. Integrated capacitors are provided (selectable mask option) for tuning of the crystal. Low current consumption and high oscillator stability are enabled by an on-chip voltage regulator.

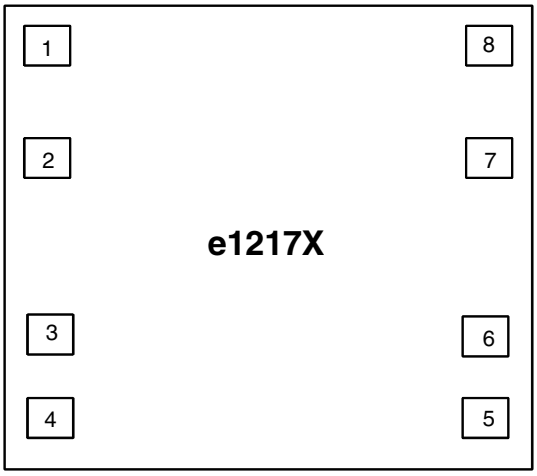
32-kHz Standard Watch CMOS IC

e1217X

4728A–CLOCK–06/03

Pad Configuration

Figure 1. Pinning



Chip size 1.06 mm × 1.02 mm
Pad size: 112 µm × 112 µm
Pad window: 100 µm × 100 µm

Pin Description

Pin	Symbol	Function
1, 4	V_{SS}	Negative supply voltage
5, 6, 8	V_{DD}	Positive supply voltage
1 to 4	OSCIN/OSCOUT	Oscillator input/output
(7/5) or (7/6)	MOT 1/2	Motor drive outputs
1 to 5, 8	RESET	Reset input
1 to 5, 8	TEST	Test input/output

Functional Description

Voltage Regulator

An integrated voltage regulator provides the oscillator with a well-controlled negative supply voltage V_{REG}. This improves the stability of the oscillator and keeps current consumption at a minimum.

Oscillator

The oscillator inverter with feedback resistor generates the 32768 Hz clock frequency. A total capacitance of 24 pF is integrated. This can be selected for COSCOUT in 2 pF increments via a mask option.

Frequency Divider

A 21-bit binary counter is provided, dividing the oscillator frequency down to 1/64 Hz. The leading six stages are connected to V_{DD} and V_{REG}, while the remaining 15 stages are connected to V_{DD} and V_{SS}.

Motor Drive Output

The e1217X contains two push-pull output buffers for driving bipolar stepping motors. During a motor pulse, the n-channel device of one buffer and the p-channel device of the other buffer are activated. The p-channel devices of both buffers are active (see Figure 3) between the two pulses.

Cycle time and pulse width can be chosen via a metal mask option (Table 1).

RESET

A debounced RESET input is provided. Connecting the RESET input to V_{DD} resets the 12 low-order stages of the frequency divider, thus disabling further motor pulses. Motor pulses, which are in progress when the reset function is applied, will be completed. After releasing the RESET pad from V_{DD}, the next motor pulse appears with a delay of one half motor cycle on the drive output opposed to the former (Figure 4). Due to the debounce circuitry on the RESET input, V_{DD} must be applied for at least 31.2 ms. During RESET the input current is limited to 8 nA typically.

Test

A test frequency of 512 Hz is output to this pad which can be measured with a high resistance probe ($R \geq 10\ M\Omega$, $C \geq 20$ pF). This signal can be used for testing and tuning the oscillator. Connecting TEST to V_{DD} for at least 4 ms changes the motor cycle time from the selected value to the test cycle time (mask options), while the motor pulse width remains unchanged (Figure 3).

This feature can be used to reduce the amount of time required for testing the mechanical parts of the watch.

Table 1. Motor Options

Motor-cycle Parameters	Value
Cycle time T_M	2, 4, 6, 8, 10, 12, 20, 24, 30, 40, 60, 80, 120 s
Motor pulse width t_M	0.98 to 14.65 ms in increments of 0.98 ms
Motor test cycle time T_{MT}	250, 125, 62.5 ms

Absolute Maximum Ratings

Absolute maximum ratings define parameter limits which, if exceeded, may permanently change or damage the device.

All inputs and outputs on Atmel's circuits are protected against electrostatic discharges. However, precautions to minimize the build-up of electrostatic charges during handling are recommended.

The circuit is protected against supply-voltage reversal for typically 5 minutes.

Parameters	Symbol	Value	Unit
Supply voltage	V_{SS}	-0.3 to +5	V
Input voltage range, all inputs	V_{IN}	$(V_{SS} - 0.3\ V) \le V_{IN} \le (V_{DD} + 0.3\ V)$	V
Output short-circuit duration		indefinite	
Power dissipation (DIL package)	P_{tot}	125	mW
Operating ambient temperature range	T_{amb}	-20 to +70	°C
Storage temperature range	T_{stg}	-40 to +125	°C
Lead temperature during soldering at 2 mm distance, 10 s	T_{sld}	260	°C

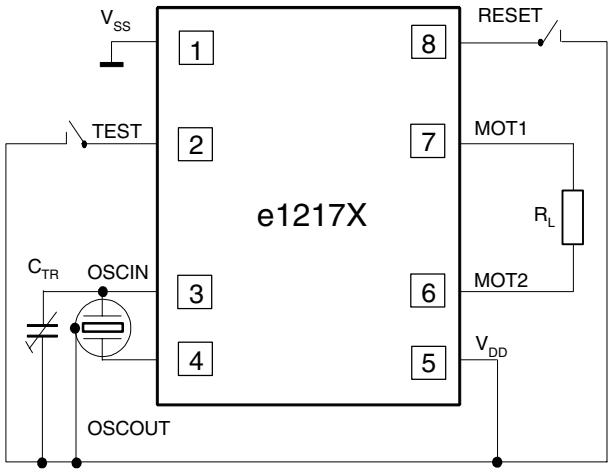
Operating Characteristics

V_{DD} = 0 V; V_{SS} = -1.55 V; T_{amb} = +25°C; C_{TR} = 15 pF, unless otherwise specified.
All voltage levels are measured with reference to V_{DD}. Test crystal as specified below.

Parameters	Test Conditions	Symbol	Min.	Typ.[1]	Max.	Unit
Operating voltage	Functional test (Figure 2)	V_{SS}	-1.3		-1.8	V
Operating current	C_{oscout} = 16 pF, R_L = R	I_{SS}		-180	-300	nA
RESET input current	RESET = V_{DD}	I_R		8		nA
Motor Outputs						
Motor output current	R_L = 2 kΩ, V_{SS} = -1.55 V	I_M	±0.7			mA
Motor period		T_M	See Table 2			s
Motor pulse width		T_M	See Table 2			ms
Motor test period		T_{MT}	See Table 2			ms
Oscillator						
Stability	ΔV_{SS} = 100 mV, C_{TR} = 5 pF	$\Delta f/f$		0.1		ppm
Start-up voltage	Startup within 2 s	V_{ST}	-1.3			V
Integrated input capacitor		$C_{OSC\ IN}$	See Table 2			pF
Integrated output capacitor	$C_{OSCOUTmax}$ = 24 pF	$C_{OSC\ OUT}$	See Table 2			pF

Note: 1. Typical parameters represent the statistical mean values.

Figure 2. Functional Test Circuit



Range of trimmer capacitance: C_{TR} = 5 pF to 30 pF

Test Crystal Specification

Frequency	f = 32,768 Hz
Series resistance	R_S = 30 kΩ
Static capacitance	C_0 = 1.5 pF
Dynamic capacitance	C_1 = 3 fF
Load capacitance	C_L = 8 pF

Additional Notes

1. It is recommended to connect the quartz case to V_{DD} (by conductive epoxy).
2. Capacitive coupling of TEST to OSCIN must be minimized by appropriate layout of the PCB to avoid disturbancing the oscillator.

Figure 3. Motor Drive Outputs in Normal Mode and Motor Test

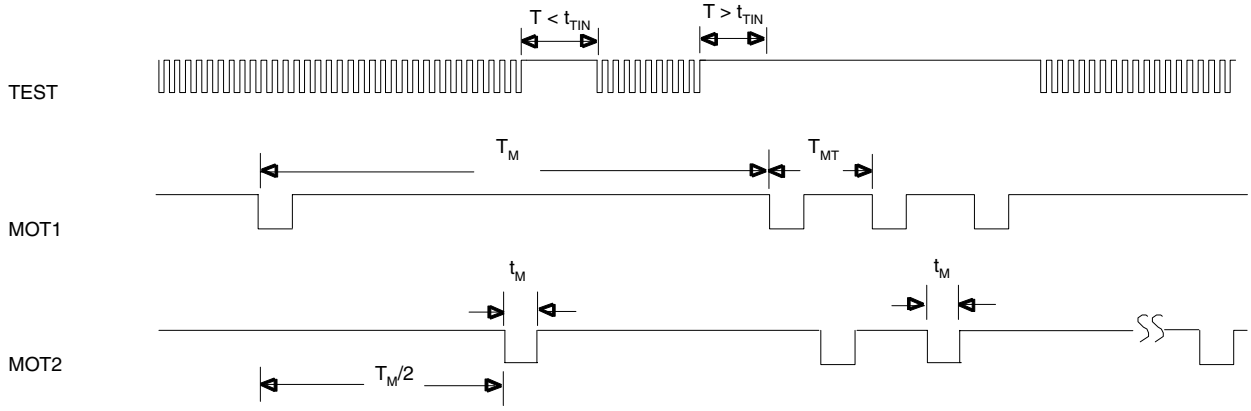
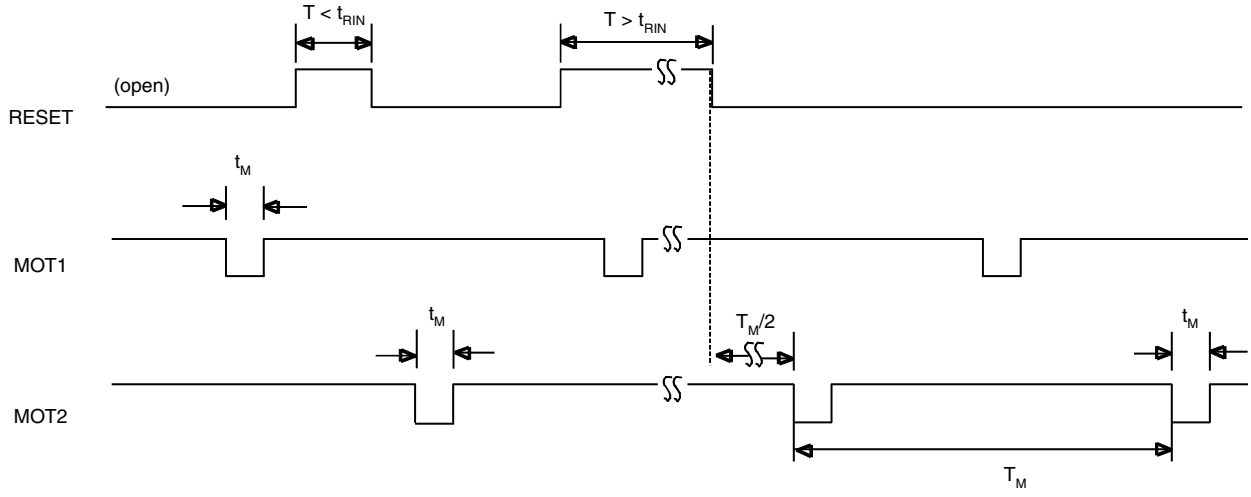


Figure 4. Motor Drive Outputs and RESET



Ordering Information

Table 2. Option List e1217X

Option	Motor			Integrated Capacitance[1]		Pad 1	Pad 2	Pad 3	Pad 4	Pad 5	Pad 6	Pad 7	Pad 8
	Cycle (T_M) s	Pulse (t_M) ms	Test (T_{MT}) ms	C_{OSCIN} pF	C_{OSCOUT} pF								
-B	2	3.9	125	2	14	V_{SS}	TEST	OSCIN	OSCOUT	V_{DD}	MOT2	MOT1	RESET
-S	2	5.9	125	2	14	V_{SS}	TEST	OSCIN	OSCOUT	V_{DD}	MOT2	MOT1	RESET
-T	10	3.9	125	2	14	V_{SS}	TEST	OSCIN	OSCOUT	V_{DD}	MOT2	MOT1	RESET
-VA	2	4.9	62.5	4	14	V_{SS}	TEST	OSCOUT	OSCIN	V_{DD}	MOT2	MOT1	RESET
-VB	2	4.9	125	4	14	OSCIN	OSCOUT	RESET	V_{SS}	TEST	MOT2	MOT1	V_{DD}
-VC	40	5.9	125	2	14	OSCIN	OSCOUT	RESET	V_{SS}	TEST	MOT2	MOT1	V_{DD}
-VF	2	3.9	62.5	4	14	OSCIN	OSCOUT	RESET	V_{SS}	MOT2	VDD	MOT1	TEST
-VH	2	3.9	62.5	4	14	V_{SS}	TEST	OSCOUT	OSCIN	V_{DD}	MOT2	MOT1	RESET
-WB	2	4.9	125	4	14	V_{SS}	TEST	OSCIN	OSCOUT	V_{DD}	MOT2	MOT1	RESET

Note: 1. On-chip stray capacitance included

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