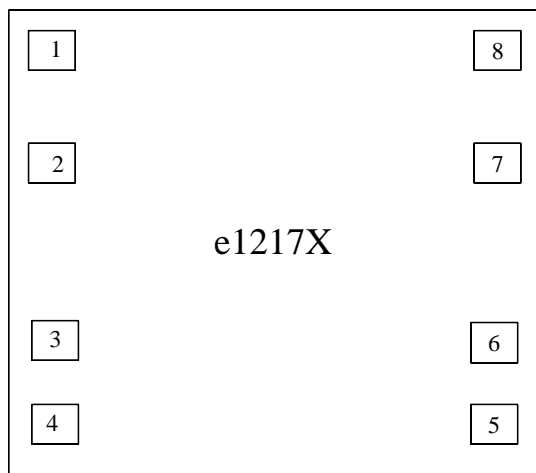


## 32-kHz Standard Watch CMOS IC

### 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

### Pad Configuration



95 9979

Figure 1. Chip size 1.06 mm x 1.02 mm  
Pad size: 112 μm x 112 μm  
Pad window: 100 μm x 100 μm

### General 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. For tuning of the crystal, integrated capacitors are provided (selectable mask option). Low current consumption and high oscillator stability are enabled by an on-chip voltage regulator.

| Pin            | Symbol          | Function                |
|----------------|-----------------|-------------------------|
| 1, 4           | V <sub>SS</sub> | Negative supply voltage |
| 5, 6, 8        | V <sub>DD</sub> | Positive supply voltage |
| 1 to 4         | OSCIN/<br>OSCOU | 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       |

### Absolute Maximum Ratings

| Parameters   | Symbol           | Value  | Unit |
|--|------------------|--|------|
| Supply voltage   | V <sub>SS</sub>  | -0.3 to +5   | V    |
| Input voltage range, all inputs                          | V <sub>IN</sub>  | (V <sub>SS</sub> -0.3 V) ≤ V <sub>IN</sub> ≤ (V <sub>DD</sub> + 0.3 V) | V    |
| Output short circuit duration                            |                  | indefinite   |      |
| Power dissipation (DIL package)                          | P <sub>tot</sub> | 125  | mW   |
| Operating ambient temperature range                      | T <sub>amb</sub> | -20 to +70   | °C   |
| Storage temperature range                                | T <sub>stg</sub> | -40 to +125  | °C   |
| Lead temperature during soldering at 2 mm distance, 10 s | T <sub>sld</sub> | 260  | °C   |

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

All inputs and outputs on Atmel Wireless & Microcontrollers' 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.

## 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

An oscillator inverter with feedback resistor is provided for generation of 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 (figure 3) between two the pulses.

Cycle time and pulse width can be chosen via a metal-mask option (table1).

### RESET

A debounced RESET input is provided. Connecting the RESET input to  $V_{DD}$  resets the low order 12 stages of the frequency divider, thus disabling further motor pulses. Motor pulses in progress when the reset function is applied are 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 ( $R \geq 10 \text{ M}\Omega$ ,  $C \leq 20 \text{ pF}$ ). 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

|                                |   |
|--------------------------------|---|
| 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                                 |

## Operating Characteristics

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

| Parameters                  | Test Conditions / Pins  | Symbol         | Min.            | Typ. | Max. | Unit |
|-----------------------------|---|----------------|-----------------|------|------|------|
| Operating voltage           | Functional test (figure 2)                                    | $V_{SS}$       | -1.3            |      | -1.8 | V    |
| Operating current           | $C_{oscout} = 16\text{ pF}$ , $R_L = \infty$                  | $I_{SS}$       |                 | -180 | -300 | nA   |
| RESET input current         | RESET = $V_{DD}$  | $I_R$          |                 | 8    |      | nA   |
| <b>Motor outputs</b>        |   |                |                 |      |      |      |
| Motor output current        | $R_L = 2\text{ k}\Omega$ , $V_{SS} = -1.55\text{ V}$          | $I_M$          | $\pm 0.7$       |      |      | mA   |
| Motor period                |   | $T_M$          | See option list |      |      | s    |
| Motor pulse width           |   | $T_M$          |                 |      |      | ms   |
| Motor test period           |   | $T_{MT}$       |                 |      |      | ms   |
| <b>Oscillator</b>           |   |                |                 |      |      |      |
| Stability                   | $\Delta V_{SS} = 100\text{ mV}$ ,<br>$C_{TR} = 5\text{ pF}$ , | $\Delta f/f$   |                 | 0.1  |      | ppm  |
| Start-up voltage            | Startup within 2 s  | $V_{ST}$       | -1.3            |      |      | V    |
| Integrated input capacitor  |   | $C_{OSC\ IN}$  | See option list |      |      | pF   |
| Integrated output capacitor | $C_{OSCOUT\ max} = 24\text{ pF}$                              | $C_{OSC\ OUT}$ | See option list |      |      | pF   |

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

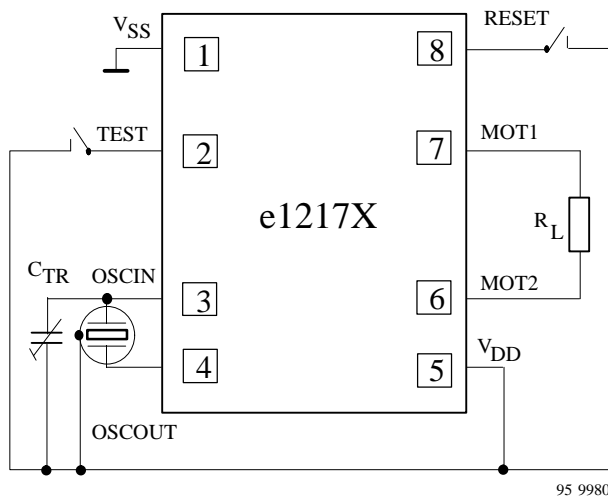


Figure 2. Functional test circuit

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

### Test Crystal Specification

|                     |                           |
|---------------------|---------------------------|
| Frequency           | $f = 32768\text{ Hz}$     |
| Series resistance   | $R_S = 30\text{ k}\Omega$ |
| Static capacitance  | $C_0 = 1.5\text{ pF}$     |
| Dynamic capacitance | $C_1 = 3\text{ fF}$       |
| Load capacitance    | $C_L = 8\text{ pF}$       |

### 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 disturbance of the oscillator.

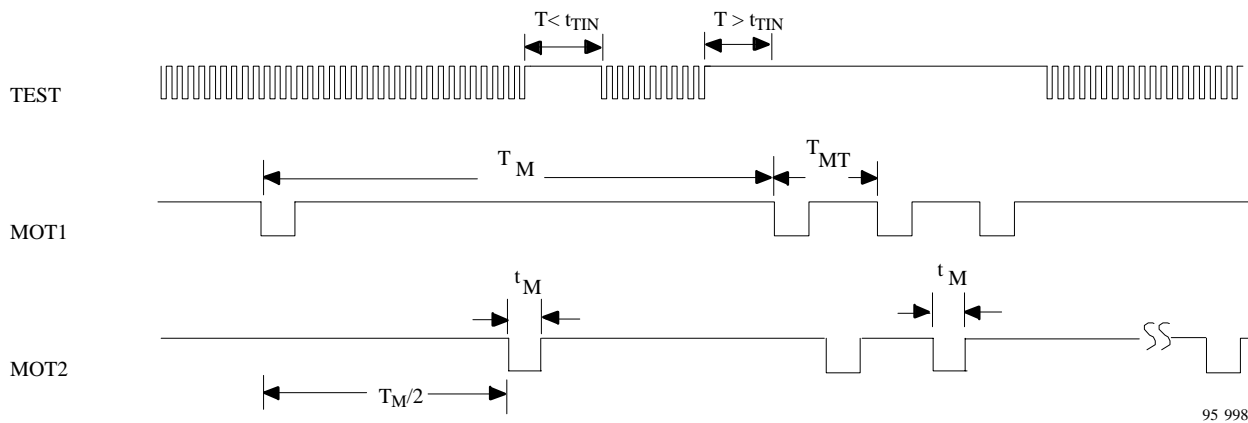


Figure 3. Motor drive outputs in normal mode and motor test

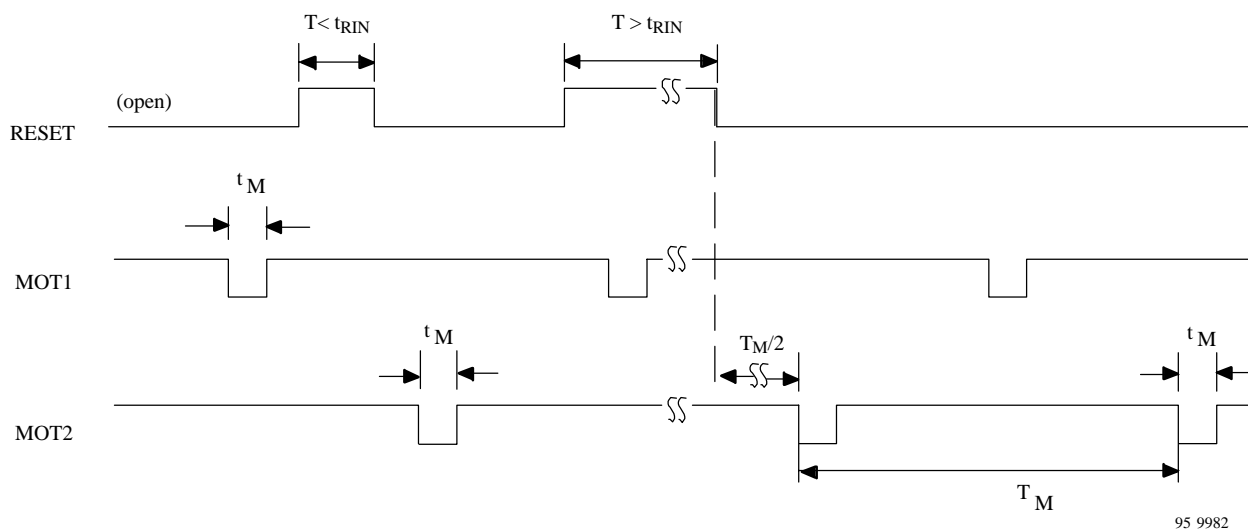


Figure 4. Motor drive outputs and RESET

Table 2 Option list e1217X–

| Option | Motor                     |                            |                            | Integrated Capacitance *) |            |                 |         |                 |                 |                 |                 |       |                 |
|--------|---------------------------|----------------------------|----------------------------|---------------------------|------------|-----------------|---------|-----------------|-----------------|-----------------|-----------------|-------|-----------------|
|        | Cycle (T <sub>M</sub> ) s | Pulse (t <sub>M</sub> ) ms | Test (T <sub>MT</sub> ) ms | COSCIN pF                 | COSCOUT pF | Pad 1           | Pad 2   | Pad 3           | Pad 4           | Pad 5           | Pad 6           | Pad 7 | Pad 8           |
| –B     | 2                         | 3.9                        | 125                        | 2                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –E     | 2                         | 6.8                        | 125                        | 2                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –I     | 2                         | 7.8                        | 125                        | 2                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –S     | 2                         | 5.9                        | 125                        | 2                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –VA    | 2                         | 4.9                        | 62.5                       | 4                         | 14         | V <sub>SS</sub> | TEST    | OSC-OUT         | OSCIN           | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –VB    | 2                         | 4.9                        | 125                        | 4                         | 14         | OSCIN           | OSC-OUT | RESET           | V <sub>SS</sub> | TEST            | MOT2            | MOT1  | V <sub>DD</sub> |
| –VC    | 40                        | 5.9                        | 125                        | 2                         | 14         | OSCIN           | OSC-OUT | RESET           | V <sub>SS</sub> | TEST            | MOT2            | MOT1  | V <sub>DD</sub> |
| –VE    | 2                         | 5.9                        | 62.5                       | 2                         | 14         | OSC-OUT         | OSCIN   | V <sub>DD</sub> | V <sub>SS</sub> | TEST            | MOT2            | MOT1  | RESET           |
| –VF    | 2                         | 3.9                        | 62.5                       | 4                         | 14         | OSCIN           | OSC-OUT | RESET           | V <sub>SS</sub> | MOT2            | V <sub>DD</sub> | MOT1  | TEST            |
| –VH    | 2                         | 3.9                        | 62.5                       | 4                         | 14         | V <sub>SS</sub> | TEST    | OSC-OUT         | OSCIN           | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –WB    | 2                         | 4.9                        | 125                        | 4                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –WG    | 20                        | 5.9                        | 125                        | 2                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |
| –WH    | 40                        | 6.8                        | 62.5                       | 2                         | 14         | V <sub>SS</sub> | TEST    | OSCIN           | OSC-OUT         | V <sub>DD</sub> | MOT2            | MOT1  | RESET           |

\*) On-chip stray capacitance included

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Atmel Germany GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany  
Telephone: 49 (0)7131 67 2594, Fax number: 49 (0)7131 67 2423