32 kHz Standard Watch CMOS IC

Features

- 32 kHz oscillator
- 1.3 – 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

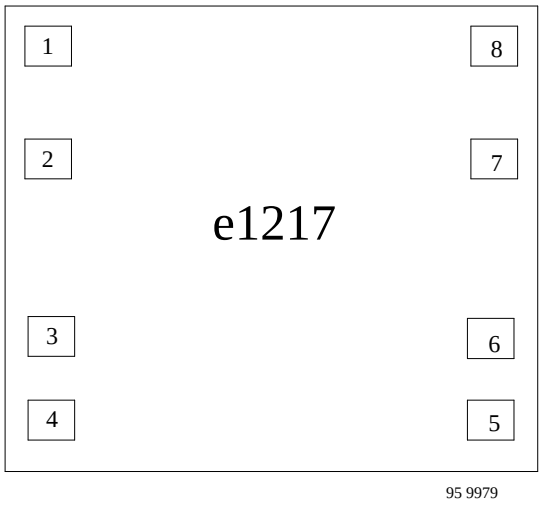


Figure 1. Chip size 1.06 mm x 1.02 mm
Pad size: 112 µm x 112 µm (pad window 100 x 100)

General Description

The e1217D 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 achieved by an on-chip voltage regulator.

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

Absolute Maximum Ratings

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

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

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

The circuits are 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

For generation of the 32768 Hz clock frequency, an oscillator inverter with feedback resistor is provided. A total capacitance of 24 pF is integrated, which can be selected for C_{OSCOUT} in 2 pF increments by 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} an V_{SS}.

Motor Drive Output

The e1217D 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 will be activated. Between two pulses the p-channel devices of both buffers are active (figure 3).

Cycle time and pulse width can be chosen from various options by metal mask (table 1).

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 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 a at least 31.2 ms. During RESET the input current is limited to 8 nA typical.

Test

A test frequency of 512 Hz is output on this pad that can be measured with a high resistance probe ($R \geq 10$ MΩ, $C \leq 20$ 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

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_{MIT}	=	250, 125, 62.5 ms

Operating Characteristics

V_{DD} = 0 V; V_{SS} = –1.55 V; T_A = +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 / Pins	Symbol	Min.	Typ.	Max.	Unit
Operating voltage	Functional test (figure 2)	V_{SS}	–1.3		–1.8	V
Operating current	C_{oscout} = 16 pF, R_L = ∞	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	mask option			s
Motor pulse width		t_M				ms
Motor test period		T_{MT}				ms
Oscillator						
Stability	ΔV_{SS} = 100 mV, C_{TR} = 5 pF, startup within 2 s	Δf/f		0.1		ppm
Start-up voltage		V_{ST}	–1.3			V
Integrated input capacitance		$C_{OSC\ IN}$	1.2			pF
Integrated output capacitance	$C_{OSCOUTmax}$ = 24 pF	$C_{OSC\ OUT}$	mask option			

Note 1: Typical parameters represent the statistical mean values

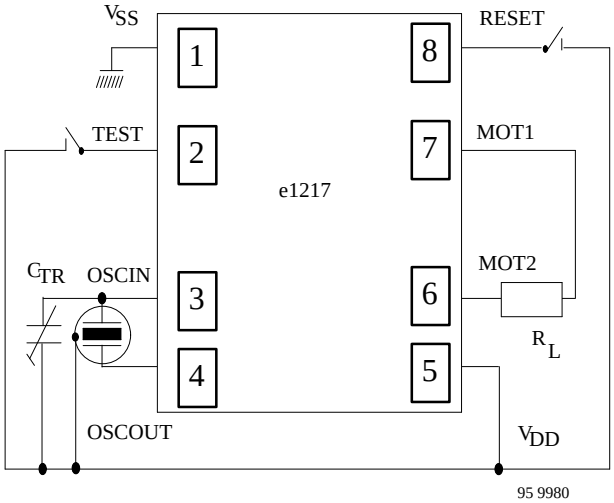


Figure 2. Functional test circuit

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

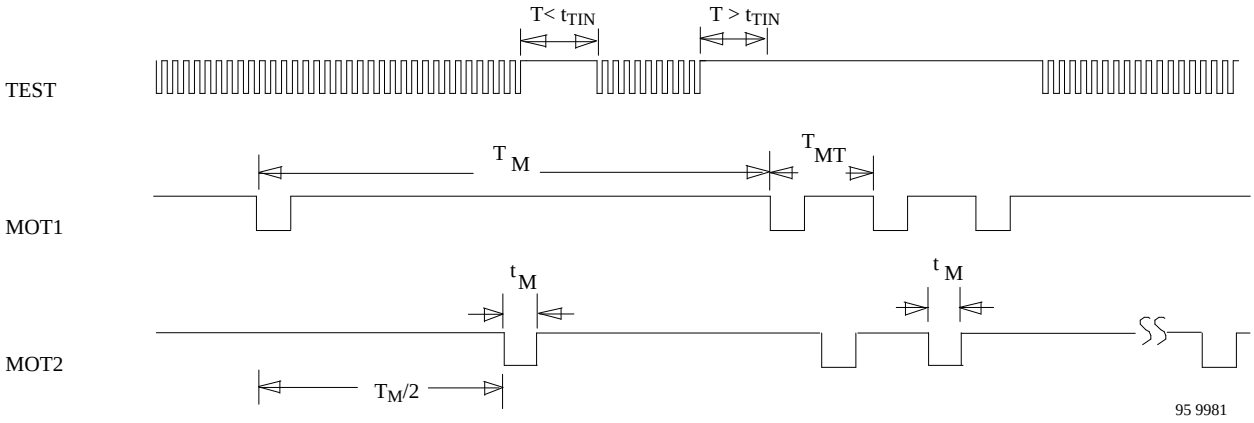
Test Crystal Specification

Frequency	f = 32768 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 disturbance of the oscillator.

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



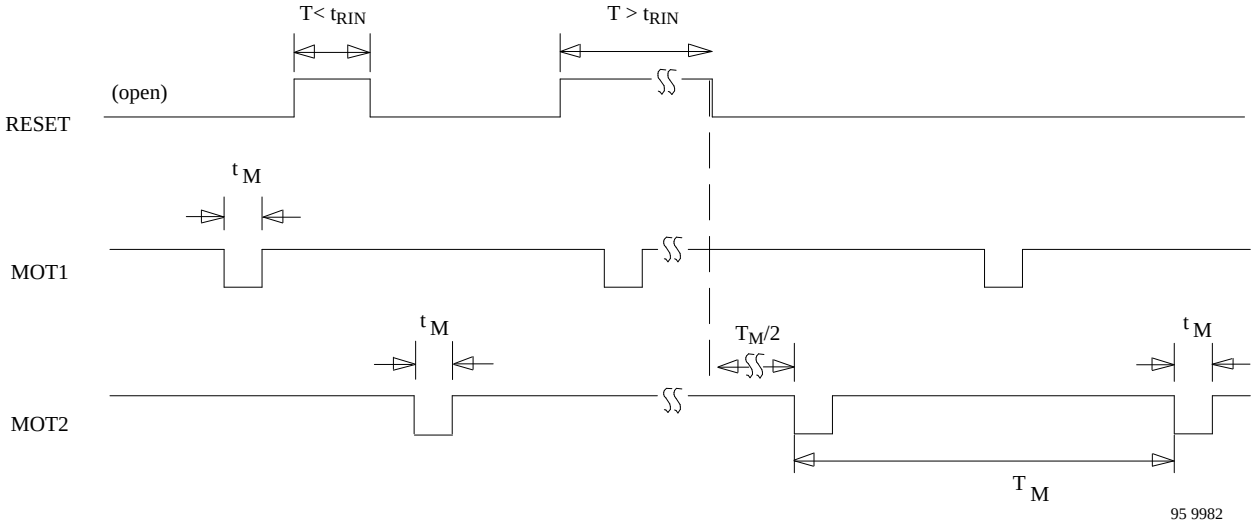


Figure 4. Motor drive outputs and RESET

Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

TEMIC can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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