# DATA SHEET

# PCA153X series
## 32 kHz clock circuit

Product specification
Supersedes data of October 1988
File under Integrated Circuits, IC16

January 1994

Philips Semiconductors

PHILIPS

# 32 kHz clock circuit PCA153X series

## FEATURES

- 32 kHz oscillator frequency
- Low current consumption; typically 2 μA, maximum 5 μA
- Low minimum supply voltage: 1.1 V
- Output for bipolar stepping motor
  - output frequency 1 Hz
  - pulse duration: see Table 1 Available types
- Test mode speed-up with an input frequency up to 20 Hz (unchanged pulse duration).

## GENERAL DESCRIPTION

The PCA153X series are silicon-gate CMOS integrated circuits specially suited for battery-operated, quartz-crystal-controlled clocks, with a bipolar stepping motor.

## ORDERING INFORMATION

| EXTENDED TYPE NUMBER | PACKAGE | | | |
|---|---|---|---|---|
| | PINS | PIN POSITION | MATERIAL | CODE |
| PCA1532P | 8 | DIL | plastic | SOT97 |
| PCA1534P | 8 | DIL | plastic | SOT97 |
| PCA1532T | 8 | SO | plastic | SO8; SOT96C |
| PCA1534T | 8 | SO | plastic | SO8; SOT96C |
| PCA1532U/10 | – | chip on film frame carrier (FFC) | – | – |
| PCA1534U/10 | – | chip on film frame carrier (FFC) | – | – |

**Table 1** Available types.

| TYPE NUMBER | PULSE WIDTH $t_p$ (ms) | CAPACITANCE OUTPUT $C_o$ (pF) | CAPACITANCE INPUT $C_i$ (pF) |
|---|---|---|---|
| PCA1532 | 23.4 | 24.0 | 3.0 |
| PCA1534 | 46.8 | 24.0 | 3.0 |

## PINNING

| SYMBOL | PIN | DESCRIPTION |
|---|---|---|
| OSC OUT | 1 | oscillator output |
| $V_{SS}$ | 2 | ground (0 V) |
| TEST IN | 3 | test input |
| M1 | 4 | motor 1 output |
| M2 | 5 | motor 2 output |
| n.c. | 6 | not connected |
| $V_{DD}$ | 7 | supply voltage |
| OSC IN | 8 | oscillator input |

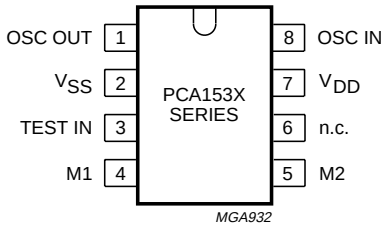



Fig.1 Pin configuration.

## FUNCTIONAL DESCRIPTION AND TESTING

### Operating mode

In the operating mode pin 3 must be left open-circuit or connected to $V_{DD}$.

### Test mode

When testing the motor, a test frequency can be applied to TEST IN (pin 3) which allows the motor outputs to be accelerated up to 20 Hz.

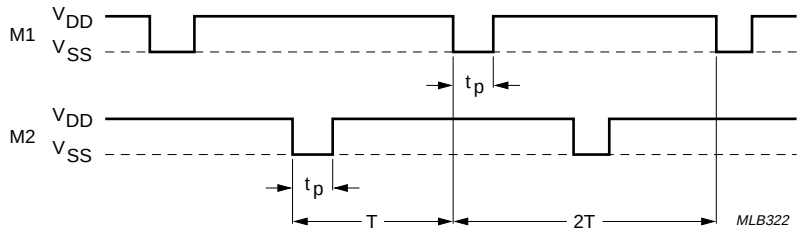



Fig.2 Motor output waveforms.

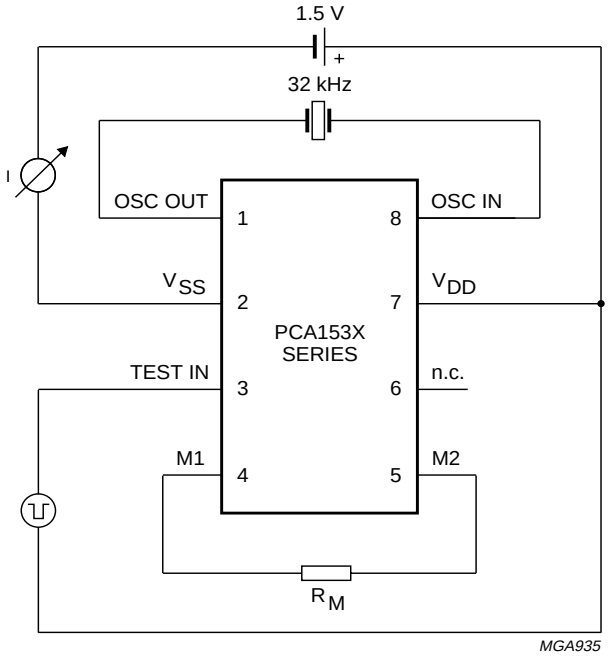



Fig.3 Test speed-up circuit.

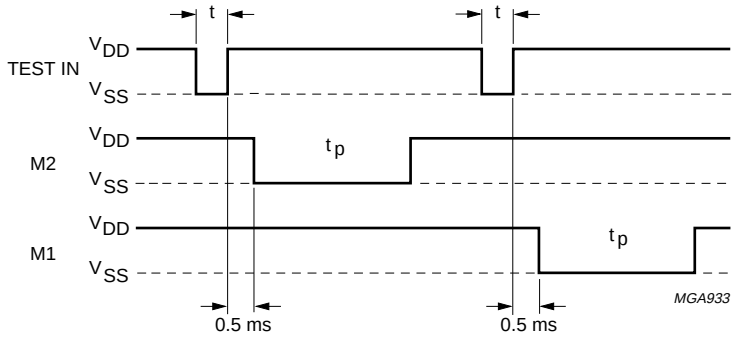



Fig.4 Test speed-up signals.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{SS}$ | supply voltage | $V_{DD}$ = 0 V; note 1 | +1.8 | –6.0 | V |
| $V_I$ | input voltage | | $V_{SS}$ | $V_{DD}$ | V |
| | output short-circuit duration at pins 4 and 5 | | | indefinite | |
| $T_{amb}$ | operating ambient temperature | | –10 | +60 | °C |
| $T_{stg}$ | storage temperature | | –30 | +125 | °C |

**Note to the “Limiting values”**

1. Connecting the battery at 1.8 V maximum with reversed polarity does not destroy the circuit, but in this condition a large current flows, which will rapidly discharge the battery.

## HANDLING

Inputs and outputs are protected against electrostatic discharges in normal handling. However, to be totally safe, it is advisable to take handling precautions appropriate to handling MOS devices (see 'Handling MOS Devices').

## CHARACTERISTICS

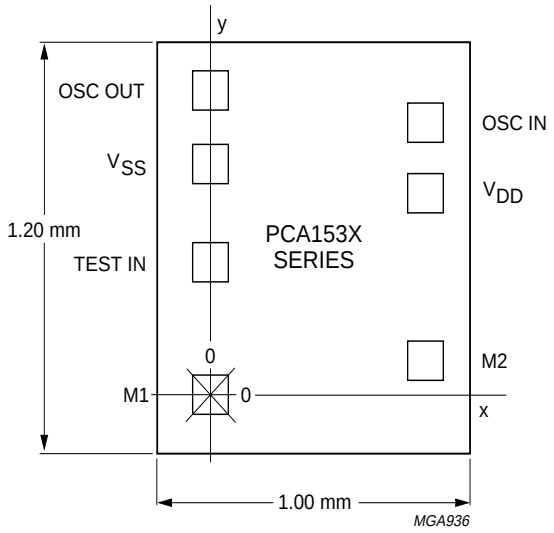
$V_{DD}$ = 0 V; $V_{SS}$ = –1.4 V; $f_{osc}$ = 32.768 kHz; $T_{amb}$ = 25 °C; crystal: $R_S$ = 20 kΩ; $C_i$ = 2 to 3 fF; $C_o$ = 1 to 3 pF; $C_L$ = 10 pF; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Supply (pins 2 and 7)** | | | | | | |
| $V_{SS1}$ | supply voltage | operating | –1.1 | – | –1.8 | V |
| $V_{SS2}$ | supply voltage | starting | –1.2 | – | – | V |
| $I_{DD}$ | supply current | $R_L = \infty$ | – | 2 | 5 | µA |
| **Motor outputs (pins 4 and 5)** | | | | | | |
| T | period | | – | 1.0 | – | s |
| $t_p$ | pulse width | | | | | |
| | PCA1532 | | – | 23.4 | – | ms |
| | PCA1534 | | – | 46.8 | – | ms |
| $I_M$ | current into load | $R_M$ = 200 Ω; $V_{SS}$ = –1.2 V | ±4 | – | – | mA |
| $R_O$ | output resistance | $R_M$ = 200 Ω | – | 60 | – | Ω |
| **Test input (pin 3)** | | | | | | |
| $I_I$ | input current | TEST IN at $V_{SS}$ | – | 70 | – | µA |
| **Oscillator (pins 1 and 8)** | | | | | | |
| $R_p$ | polarization resistance | | 3 | 10 | 30 | MΩ |
| $C_o$ | output capacitance (pin 1) | note 1 | | | | |
| | PCA1532 | | – | 24.0 | – | pF |
| | PCA1534 | | – | 24.0 | – | pF |
| $C_i$ | input capacitance (pin 8) | note 1 | | | | |
| | PCA1532 | | – | 3.0 | – | pF |
| | PCA1534 | | – | 3.0 | – | pF |
| Δf/f | frequency stability | $\Delta V_{SS}$ = 100 mV | – | $0.4 \times 10^{-6}$ | – | |

**Note to the “Characteristics”**

1. Sum of $C_i$ and $C_o$ limited to 40 pF.

## CHIP DIMENSIONS AND BONDING PAD LOCATIONS




Chip area: 1.20 μm$^2$.
Bonding pad dimensions: 120 μm x 120 μm.

Fig.5 Bonding pad locations; 7 pins.

**Bonding pad locations (dimensions in μm).**

All x/y coordinates are referenced to bottom left pad (M1), see Fig.5.

| PAD | x | y |
|---|---|---|
| OSC OUT | 0 | 880 |
| $V_{SS}$ | 0 | 670 |
| TEST IN | 0 | 380 |
| M1 | 0 | 0 |
| M2 | 675 | 94 |
| $V_{DD}$ | 675 | 575 |
| OSC IN | 675 | 785 |
| chip corner (max. value) | –180 | –180 |

## APPLICATION INFORMATION

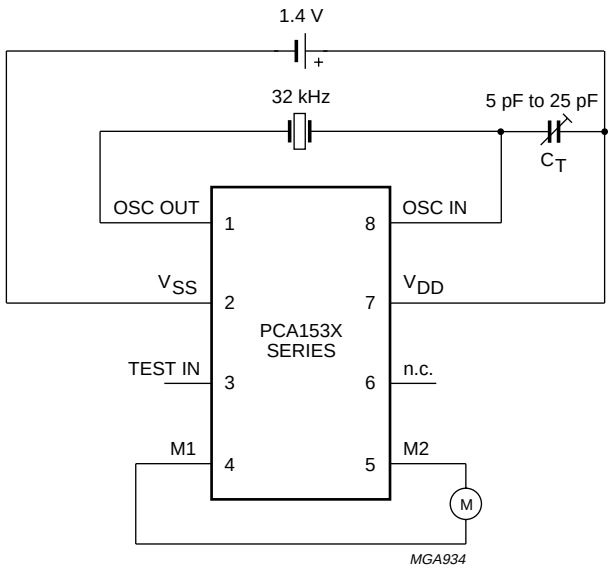
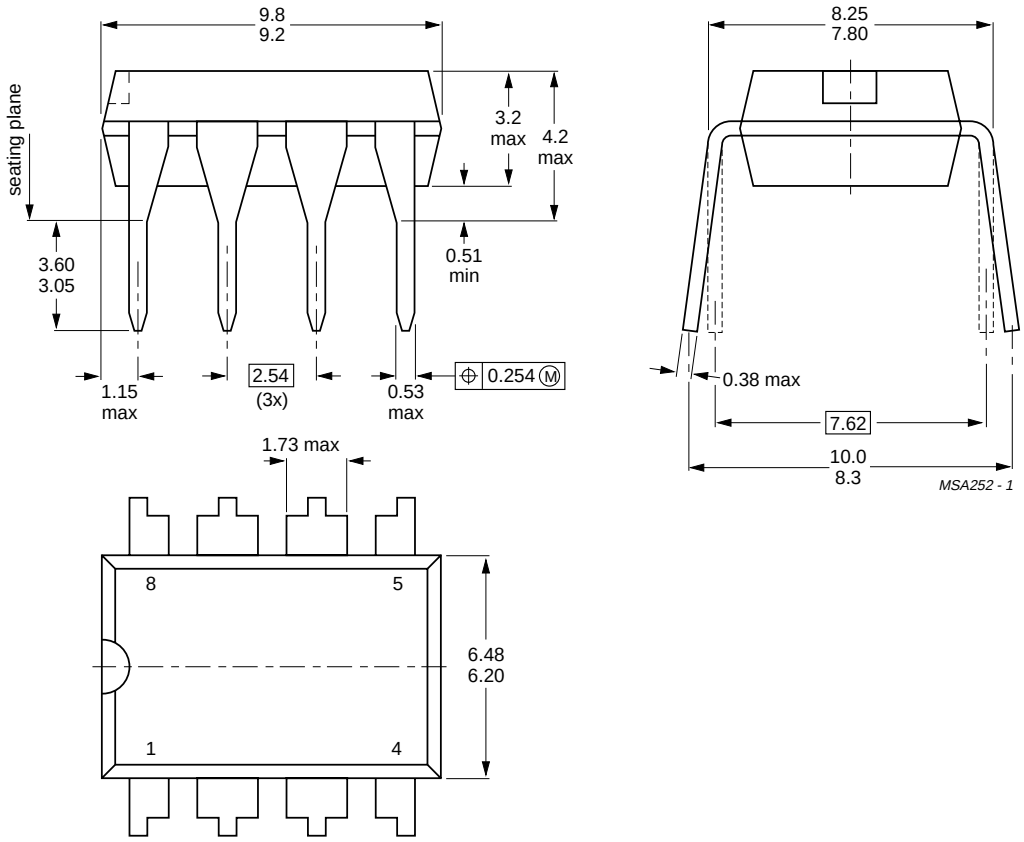


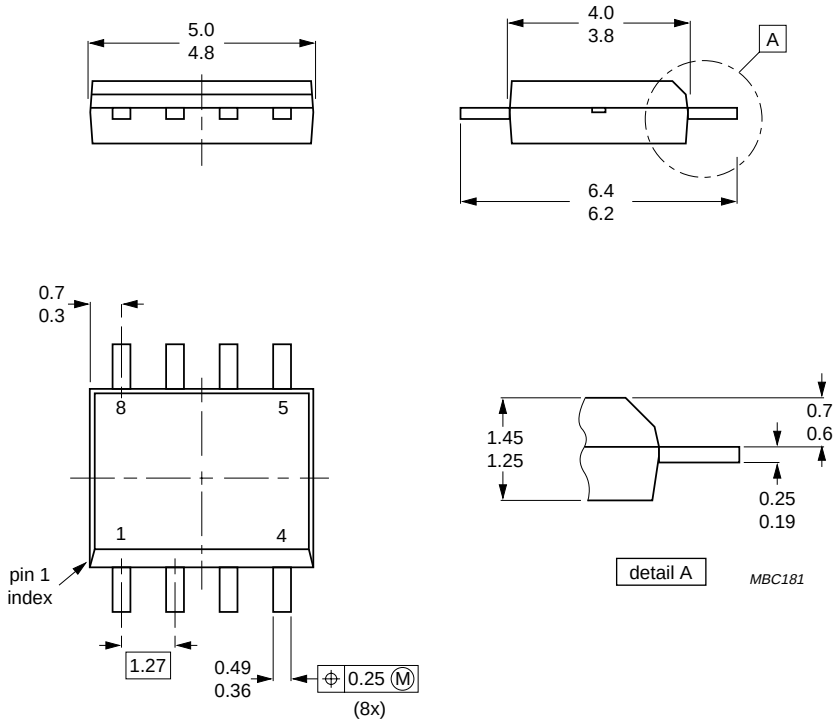

Fig.6 Typical application circuit diagram.

**PACKAGE OUTLINES**




Dimensions in mm.

Fig.7 8-lead dual in-line; plastic (SOT97).




Dimensions in mm.

Fig.8 8-lead small outline; plastic (SO8; SOT96C).

## SOLDERING

### Plastic dual in-line packages

BY DIP OR WAVE

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 s. The total contact time of successive solder waves must not exceed 5 s.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

REPAIRING SOLDERED JOINTS

Apply the soldering iron below the seating plane (or not more than 2 mm above it). If its temperature is below 300 °C, it must not be in contact for more than 10 s; if between 300 and 400 °C, for not more than 5 s.

### Plastic small outline

BY WAVE

During placement and before soldering, the component must be fixed with a droplet of adhesive. After curing the adhesive, the component can be soldered. The adhesive can be applied by screen printing, pin transfer or syringe dispensing.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder bath is 10 s, if allowed to cool to less than 150 °C within 6 s. Typical dwell time is 4 s at 250 °C.

A modified wave soldering technique is recommended using two solder waves (dual-wave), in which a turbulent wave with high upward pressure is followed by a smooth laminar wave. Using a mildly-activated flux eliminates the need for removal of corrosive residues in most applications.

BY SOLDER PASTE REFLOW

Reflow soldering requires the solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the substrate by screen printing, stencilling or pressure-syringe dispensing before device placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 s according to method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 min. at 45 °C.

REPAIRING SOLDERED JOINTS (BY HAND-HELD SOLDERING IRON OR PULSE-HEATED SOLDER TOOL)

Fix the component by first soldering two, diagonally opposite, end pins. Apply the heating tool to the flat part of the pin only. Contact time must be limited to 10 s at up to 300 °C. When using proper tools, all other pins can be soldered in one operation within 2 to 5 s at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages.)

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to the substrate by dipping or by an extra thick tin/lead plating before package placement.

## DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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