



GENERAL DESCRIPTION

C1016A is an integrated circuit fabricated in Poly silicon-Gate CMOS technology for application in bipolar stepping motor driven analog timepieces. Only minute pulse appears across two motor outputs and second pulse has been suppressed. It consists of a 32 KHz oscillator, frequency divider, voltage regulator and push-pull motor driver. A programmable oscillator output integrated capacitor is built-in so that only an external trimming capacitor and crystal are required by the oscillator. Low current consumption and high oscillator stability are achieved by an on-chip voltage regulator.

FUNCTIONAL DESCRIPTION

Oscillator

An integrated oscillator with mask selectable capacitor in OSCOUT are provided so that only a 32768 Hz quartz crystal and a trimming capacitor is required to complete the oscillator circuit. If a trimmer capacitor is not used, another built-in capacitor at OSCIN can be mask programmed as an oscillator input capacitor.

Voltage regulator

A well controlled reduced negative supply voltage is provided by a built-in integrated voltage regulator. It helps in improving the oscillator stability as well as reducing the power consumption.

Push-pull motor drivers

C1016A has two push-pull output drivers. During a motor pulse the n-channel transistor of one driver and the p-channel transistor of the other driver are on. Between two consecutive motor pulses the n-channel transistors of both drivers are on. The motor period is 120 second, the output waveform consists of 60s and 60s segments as shown in Figure 2. The motor pulse width is 15.625/23.4/31.25ms by mask option.

Test

The test pad can be used to monitor the oscillating frequency which is divided down to 512 Hz and can be measured with a high resistance probe. To enter the test mode, this pad should be pull to VDD longer than the debounced time (3ms) and the motor cycle time would change from 120 seconds to the test cycle time, while the motor pulse width remains unchanged.

FEATURES

- Built-in 32768 Hz oscillator.
- Mask selectable integrated oscillator capacitors.
- 1.3 ~ 1.8V operating voltage range.
- Single battery operation and low current consumption achieved by built-in voltage regulator.
- Low resistance push-pull motor output drivers.
- Motor fast test function.
- Low operating current.

Electroset/Reset

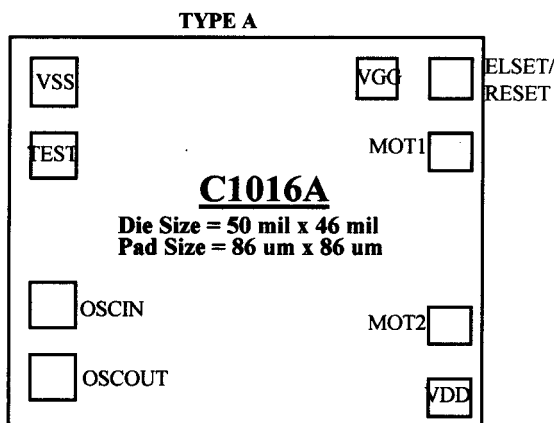
Electroset or Reset function is selectable for pad ELSET/RESET by mask option. ELSET is function key of electro-setting watch and RESET is function key of stopping watch.

In reset option, a debounced circuit with debounced time of 23.4 ms is provided for the RESET input. Connecting this pad to VDD longer than the debounced time 23.4ms would disable further motor pulses. Motor pulse in progress will be completed when RESET is applied. Disconnecting this pad from VDD, the next motor pulses would be output after half motor cycle time with polarity opposite to the previous one (Figure 3).

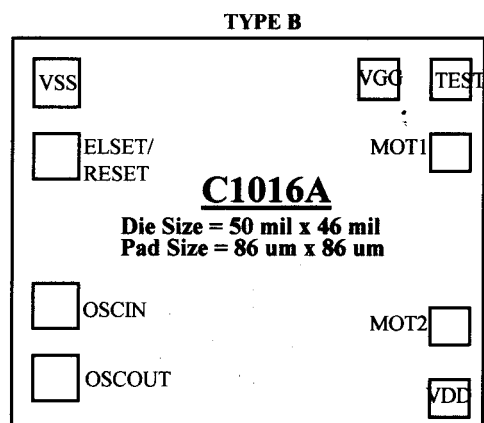
In electro-set option, connecting the ELSET pad to VDD for longer than the maximum debounce time with duration less than T_0 , which is 0.5 or 0.75 or 0.875 second by mask option, a motor pulse would appear with polarity opposite to the previous one. This provide a fine adjustment to set the watch one minute per step (figure 4). To accelerate the time adjustment, ELSET pad should be connected to VDD longer than 0.5 or 0.75 or 0.875 second (by mask option) and a motor pulse train would appear at the motor output with period of 125 ms (figure 5). The minimum and maximum debounce time to enter the electro-set mode is 78.125ms and 156.25ms respectively.

The location of pad ELSET/RESET in C1016A layout can be exchanged with pad TEST by changing metal mask.

PAD CONFIGURATION



NOTE:
Substrate should be either left open or connected to V_{DD}.



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Signal	Description	Pads' Co-ordinates (for TYPE B)
VSS	Negative supply voltage	(106.1, 387.9)
ELSET/RESET	Electro-set / Reset input	(106.2, 217.8)
OSCIN / OSCOUT	Oscillator input / output	(106.1, -224.0) / (106.1, -430.4)
VDD	Positive supply voltage	(1079.5, -483.8)
VGG	Voltage regulator	(907.9, 398.9)
TEST	Test input / output	(1079.5, 392.9)
MOT1 / 2	Motor drive outputs	(1078.0, 214.9) / (1079.5, -317.7)

ABSOLUTE MAXIMUM RATINGS

Parameter	Value	Unit
Power supply voltage (V _{DD} - V _{SS})	- 0.3 ~ + 3.0	V
Input voltage range, all inputs	(V _{SS} - 0.3) ≤ V _I ≤ (V _{DD} + 0.3)	V

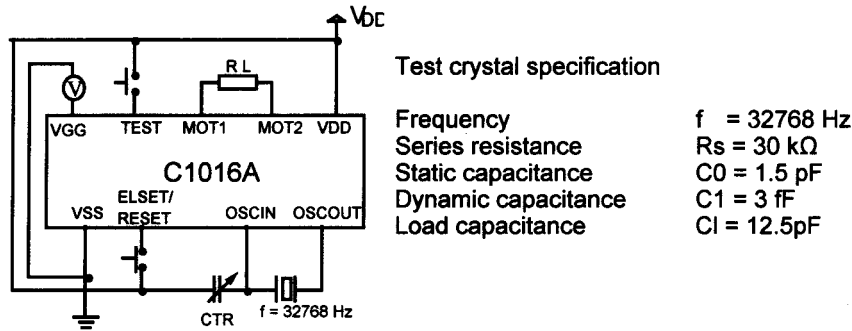
Note: Absolute maximum ratings state parameter limits exceeding which the device may be permanently changed or damaged.

ELECTRICAL CHARACTERISTICS

(V_{DD} = 0V; V_{SS} = -1.5V; T_a = +25°C; unless otherwise specified)
All voltage levels are measured with reference to V_{DD}.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Operating voltage	V _{SS}	-1.25	-	-1.8	V	Functional test (Fig.1)
Operating current	I _{SS}	-	-	-550	nA	COSCIN = 10 pF; R _L = ∞
ELSET/RESET input current	I _R	-	8	-	nA	ELSET/RESET = V _{DD}
Motor Outputs						
Motor output current	I _M	±0.9	-	-	mA	R _L = 1.5KΩ
Motor cycle time	**T _M	120, 40			s	-
Motor pulse width	**t _m	5.9/9.8/15.625/23.4/31.25			ms	-
Oscillator						
start-up voltage	V _{st}	-1.25	-	-	V	within 2 s (Fig. 1)
Integrated input capacitance	*COSC IN	4			pF	
Integrated output capacitance	*COSC OUT	14			pF	

Note : **1. T_M and t_m are mask optional. Detail can be checked in OPTION LIST (page 4).
* 2. COSCIN, COSCOUT are selectable. The max. valum of COSCIN + COSCOUT is 42PF



Note: Substrate should be either left open or connected to VDD.

Figure 1 : Functional test

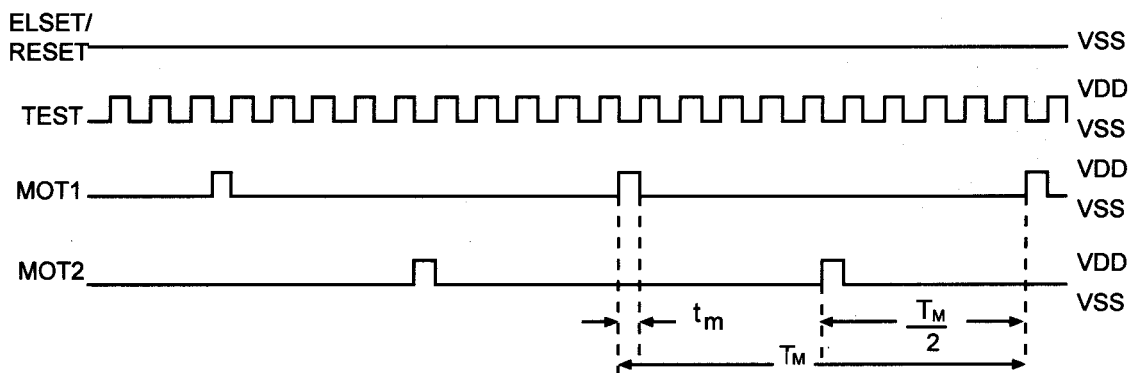


Figure 2 : Motor Output in normal mode

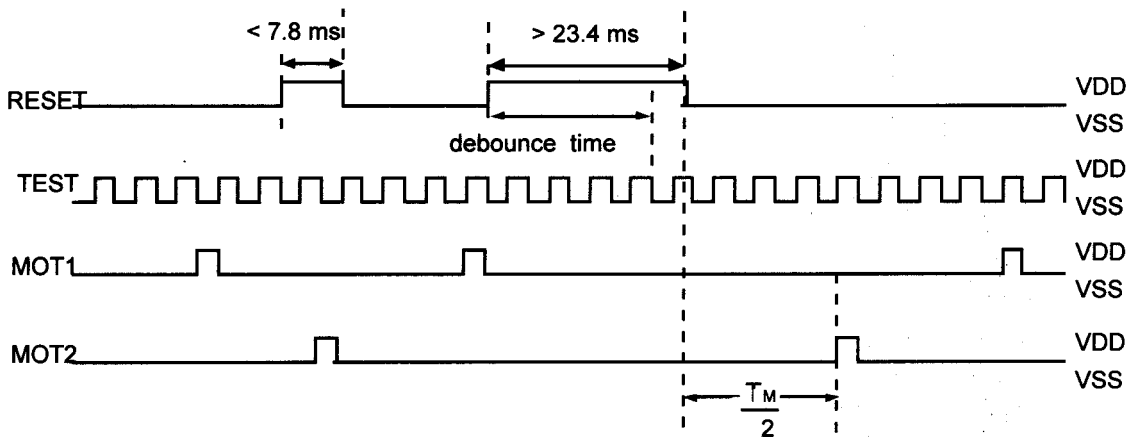


Figure 3 : Motor Output and RESET

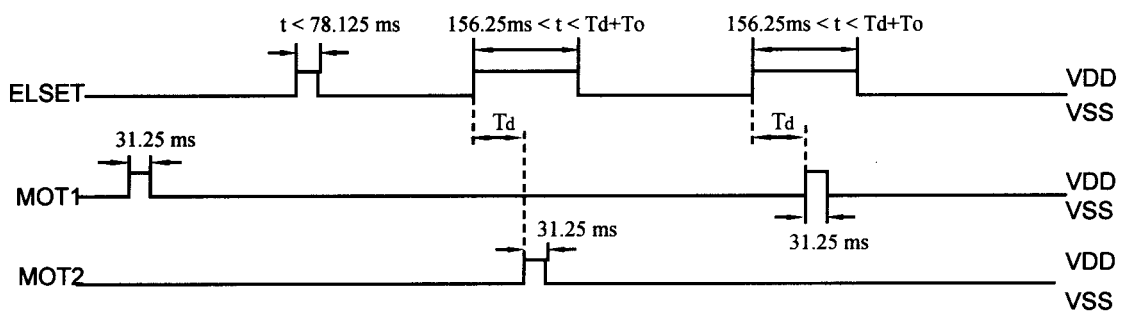


Figure 4 : Motor Output and ELSET (step by step time adjustment $156.25 \text{ ms} < t < T_d + T_o$)

Note: Td ----- debounce time
 To ----- it is optional between 0.5 or 0.75 or 0.875 second

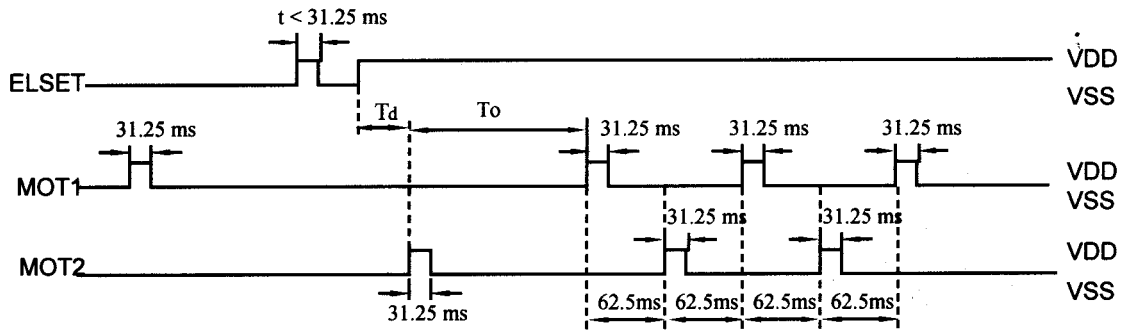


Figure 5: 16 Hz Motor output when ELSET/RESET is held at Vdd longer than Td+To second
 (78.125ms < Td < 156.25ms)

Note: Td ----- debounce time (78.125ms < Td < 156.25ms)
 To ----- it is optional between 0.5 or 0.75 or 0.875 second

OPTION LIST

Option Name	Pulse width of Motor Output (MS)	Cycle time of Motor Output (S)	COSCIN (PF)	COSCOU (PF)	Delay Time of Entering ELSET	Debounce Time (Second)	Pad Order
C1016A-1	23.4	120	4	14	0.5	0.875	TYPE A
C1016A-2	5.9	40	4	14	0.5	0.875	TYPE A
C1016A-3	15.625	40	4	14	0.5	0.875	TYPE A
C1016A-4	9.8	120	4	14	0.5	0.875	TYPE A
C1016A-5	6.8	120	4	14	0.5	0.875	TYPE A