RCL Semiconductors Ltd.

32 KHz Standard Watch CMOS IC

C1913

GENERAL DESCRIPTION

The C1913 is an integrated circuit fabricated in Polysilicon-Gate CMOS technology for application in bipolar stepping motor driven analog timepieces. 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.

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.
- Mask programmable motor pulse width, motor test cycle time and pad designation.
- Low operating current.

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. The capacitance of both built-in capacitors can be programmed in 2 pF step size with maximum total capacitance of 35 pF.

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

The C1913 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 (Figure 2). Cycle time and pulse width can be chosen from various options by the metal mask.

Reset

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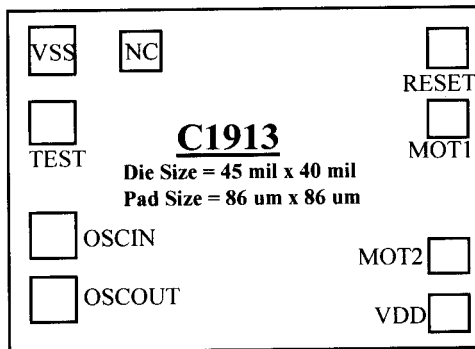
Test

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 the selected value to the test cycle time (mask options), while the motor pulse width remains unchanged.

TABLE 1 : OPTION LIST FOR C1913 MOTOR OUTPUTS

Cycle time TM	=	2
Motor pulse width t_m	=	0.98ms X N (N= 1 to 15)
Motor test cycle time TMT	=	250, 125, 62.5 ms

050803

PAD CONFIGURATION

```
VSS    NC                      □
                            RESET
 □          C1913           □
TEST   Die Size = 45 mil x 40 mil   MOT1
       Pad Size = 86 um x 86 um

 □ OSCIN
                            MOT2 □
 □ OSCOUT
                            VDD □
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Note : Substrate should be either left open or connected to VDD.

Signal	Description	Pads' Co-ordinates
VSS	Negative supply voltage	(-94.9, 280.5)
TEST	Test input / output	(-94.9, 139.0)
OSCIN / OSCOUT	Oscillator input / output	(-94.9, -173.6) / (-94.9, 385.8)
NC	For test internal VGG , cannot be used for bonding	(114.6, 280.6)
RESET	Reset input	(744.4, 280.6)
MOTI / 2	Motor drive outputs	(744.4, 85.9) / (744.4, -266.3)
VDD	Positive supply voltage	(744.4, -441.0)

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) ≤ V1 ≤ (V_{DD} + 0.3)	V
Operating ambient temperature range	-10 ~ +60	°C
Storage temperature range	-40 ~ +125	°C

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; Ta = +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}	-1.3	–	-1.8	V	Functional test (Fig.1)
Operating current	I_{SS}	–	–180	-300	nA	Coscout = 16 pF; R_L = ∞
RESET input current	I_R	–	5	–	nA	RESET = V_{DD}
Motor Outputs						
Motor output current	I_M	±0.7	–	–	mA	R_L= 2KΩ, V_{SS} = -1.55V
Cycle time	T_M		2		s	–
Motor pulse width	t_m		Mask option		ms	–
Motor test cycle time	T_{MT}		Mask option		ms	–
Oscillator						
start-up voltage	V_{st}	-1.3	–	–	V	within 2 s
Integrated input capacitance	$C_{OSC\,IN}$		Mask option		–	Max. of ($C_{OSC\,IN}$ + $C_{OSC\,OUT}$) = 35PF
Integrated output capacitance	$C_{OSC\,OUT}$		Mask option		–	

Note 1 : Typical parameters represent the statistical mean values.

RCL reserves the right to make changes to this specification at any time without notice
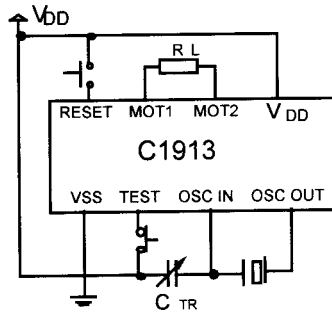
Test crystal specification

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 = 10pF

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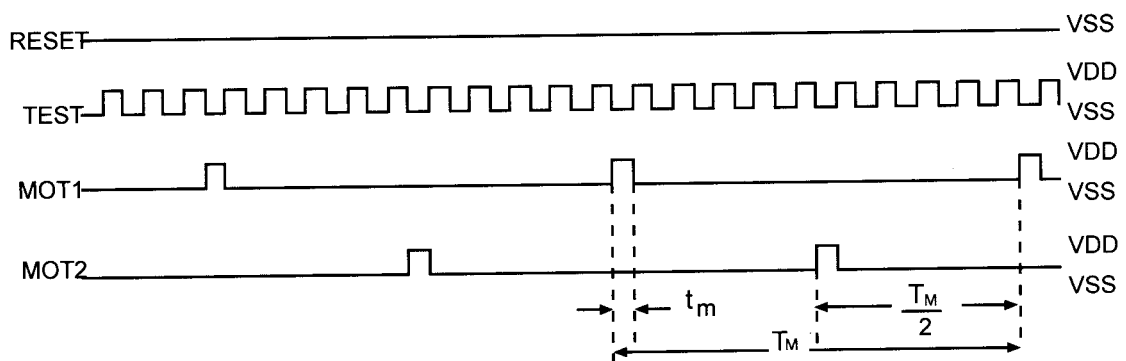   or connected to Vdd.

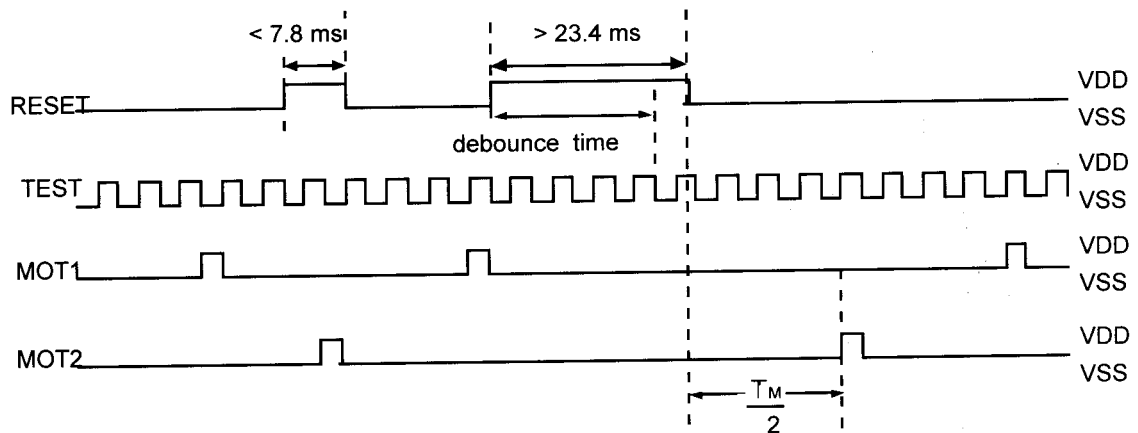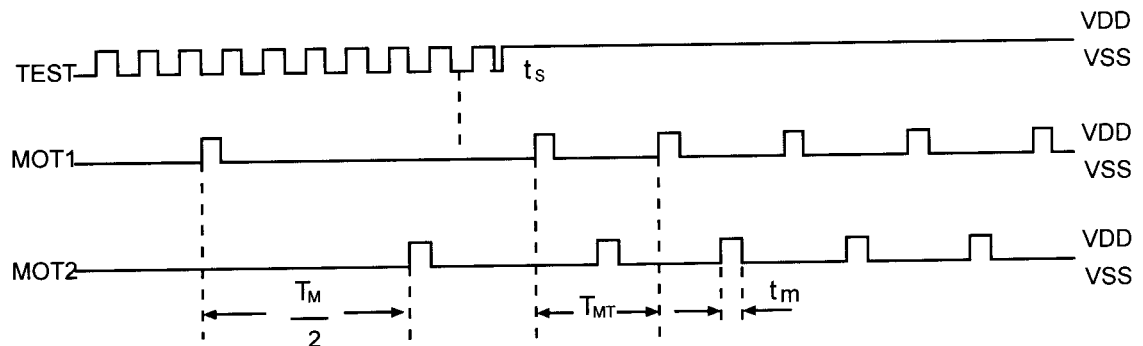Figure 1 : Functional test

Figure 2 : Motor drive output in normal mode

Figure 3 : Motor drive output and RESET

Figure 4 : TEST mode : VDD applied to TEST at time t= t_S

OPTION LIST OF C1913

Option	Motor Output			IC Cap **		PAD DESIGNATION								
	Cycle time	Pulse width	Test cycle time	OSC IN	OSC OUT									
	s	ms	ms	PF	PF	Pad1	Pad2	Pad3	Pad4	Pad5	Pad6	Pad7	Pad8	Pad9
C1913 -1	2	5.9	125	20	14	V_{SS}	TEST	OSCIN	OSCOUT	V_{DD}	MOT2	MOT1	RESET	-
C1913 -2	2	5.9	125	14	11	V_{SS}	TEST	OSCIN	OSCOUT	V_{DD}	MOT2	MOT1	RESET	-

** on-chip stray capacitance included