National Semiconductor

MM5368 CMOS Oscillator Divider Circuit

General Description

The MM5368 is a CMOS integrated circuit generating 50 or 60 Hz, 10 Hz, and 1 Hz outputs from a 32 kHz crystal (32,768 Hz). For the 60 Hz selected output the input time base is divided by 546.133, for the 50 Hz mode it is divided by 655.36. The 50/60 Hz output is then divided by 5 or 6 to obtain a 10 Hz output which is further divided to obtain a 1 Hz output. The 50/60 Hz select input can be floated for a counter reset.

Features

- 50/60 Hz output
- 1 Hz output
- 10 Hz output
- Low power dissipation
- Fully static operation
- Counter reset
- 3.5V–15V supply range
- On-chip oscillator—tuning and load capacitors are the only required external components besides the crystal. (For operation below 5V it may be necessary to use an ~ 1 MΩ pullup on the oscillator output to insure start-up.)

Block and Connection Diagrams

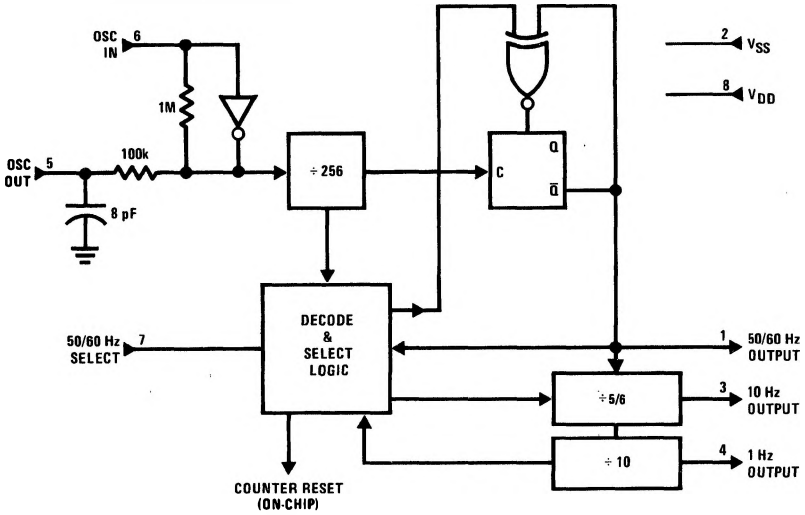

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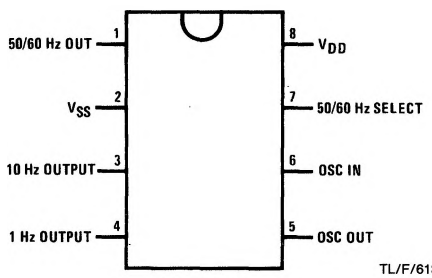
FIGURE 1

Dual-In-Line Package



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Top View

FIGURE 2

Order Number MM5368N
See NS Package Number N08E

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Voltage at Any Pin	$-0.3V$ to $V_{DD} + 0.3V$
Operating Temperature	0°C to +70°C
Storage Temperature	−65°C to +150°C
Maximum V_{DD} Voltage	16V
Operating V_{DD} Range	$3.5V \leq V_{DD} \leq 15V$
Lead Temperature (Soldering, 10 sec.)	300°C

Electrical Characteristics T_A within operating range, $V_{SS} = 0V$

Parameter	Conditions	Min	Typ	Max	Units
Quiescent Current Drain	$V_{DD} = 15V$; 50/60 Select Floating			10	μA
Operating Current Drain	$f_{IN} = 32$ kHz, $V_{DD} = 3.5V$			60	μA
	$f_{IN} = 32$ kHz, $V_{DD} = 15V$			1500	μA
Maximum Input Frequency	$V_{DD} = 3.5V$			64	kHz
	$V_{DD} = 15V$			500	kHz
Output Current Levels	$V_{DD} = 5V$				
Logical "1", Source	$V_{OH} = V_{SS} + 2.7V$			−400	μA
Logical "0", Sink	$V_{OL} = V_{SS} + 0.4V$	400			μA
	$V_{DD} = 9V$				
Logical "1", Source	$V_{OH} = V_{SS} + 6.7V$			−1500	μA
Logical "0", Sink	$V_{OL} = V_{SS} + 0.4V$	1500			μA
Input Current Levels	50/60 Select Input (Note 1)				
Logical "1" (I_{IH})	$V_{DD} = 3.5V$, $V_{IN} \geq 0.9\ V_{DD}$			50	μA
Logical "1" (I_{IH})	$V_{DD} = 15V$, $V_{IN} \geq 0.9\ V_{DD}$			3	mA
Logical "0" (I_{IL})	$V_{DD} = 3.5V$, $V_{IN} \geq 0.1\ V_{DD}$			20	μA
Logical "0" (I_{IL})	$V_{DD} = 15V$, $V_{IN} \geq 0.1\ V_{DD}$			1	mA

Note 1: The input current level test is performed by first measuring the open circuit voltage at the 50/60 Hz select pin. If the voltage is "high", make the I_{IH} test. If the voltage is "low", make the I_{IL} test. The state of the 50/60 Hz select pin may be changed by applying a pulse to OSC IN (pin 6) while the 50/60 Hz pin is open circuit.

Functional Description *(Figure 1)*

The MM5368 initially divides the input time base by 256. From the resulting frequency (128 Hz for 32 kHz crystal) 8 clock periods are dropped or eliminated during 60 Hz operation and 28 clock periods are eliminated during 50 Hz operation. This frequency is then divided by 2 to obtain a 50 or 60 Hz output. This output is not periodic from cycle to cycle; however, the waveform repeats itself every second. Straight divide by 5 or 6 and 10 are used to obtain the 10 Hz output and the 1 Hz outputs.

The 60 Hz mode is obtained by tying pin 7 to V_{DD}. The 60 Hz output waveform can be seen in *Figure 3*. The 10 Hz and 1 Hz outputs have an approximate 50% duty cycle. In the 50 Hz mode the 50/60 select input is tied to V_{SS}. The 50 Hz output waveform can be seen in *Figure 3*. The 10 Hz output has an approximate 40% duty cycle and the 1 Hz output has an approximate 50% duty cycle.

For the 50/60 Hz select input floating, the counter chain is held reset, except for the initial toggle flip-flop which is needed for the reset function. A reset may also occur when the input is switched *(Figure 4)*. To insure the floating state, current sourced from the input must be limited to 1.0 μA and current sunk by the input must be limited to 1.0 μA for $V_{DD} = 3.5V$.

Timing Diagrams

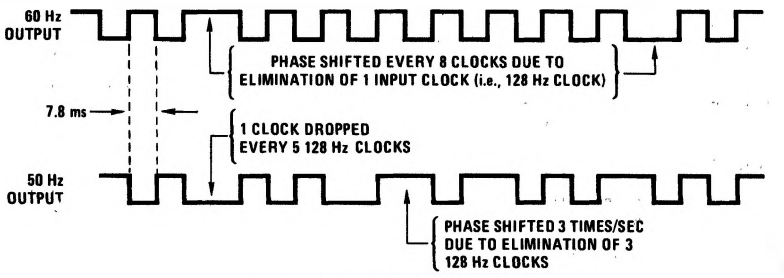
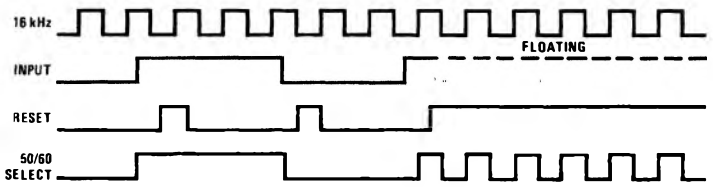


FIGURE 3. 50/60 Hz Output

Timing Diagrams (Continued)



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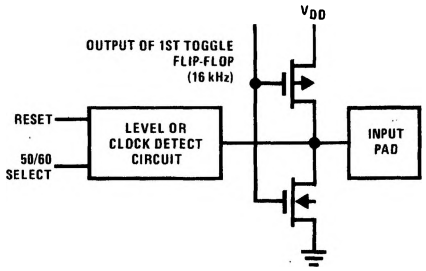

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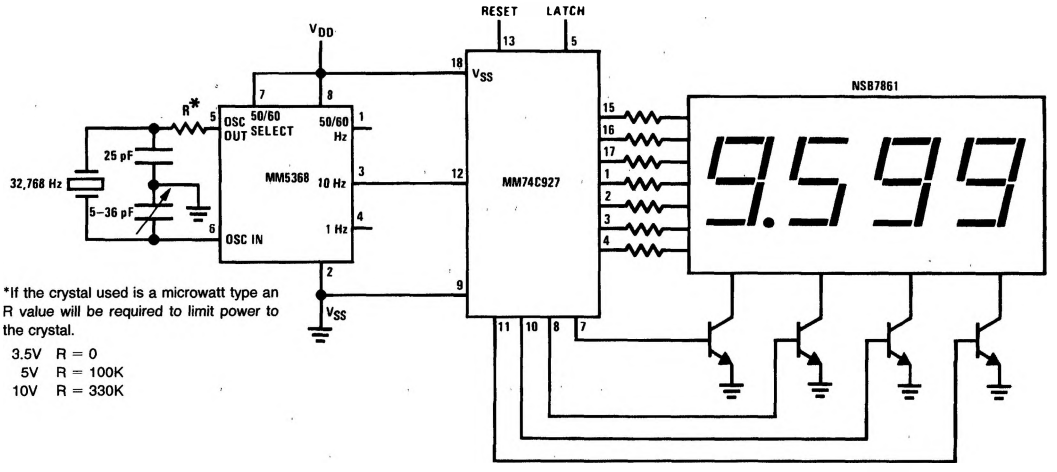
FIGURE 4. 50/60 Select and Reset

Typical Applications



*If the crystal used is a microwatt type an R value will be required to limit power to the crystal.

3.5V R = 0
5V R = 100K
10V R = 330K

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FIGURE 5. 10 Minute (9:59.9) Timer