

## 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  $\sim 1\text{ M}\Omega$  pullup on the oscillator output to insure start-up.)

### Block and Connection Diagrams

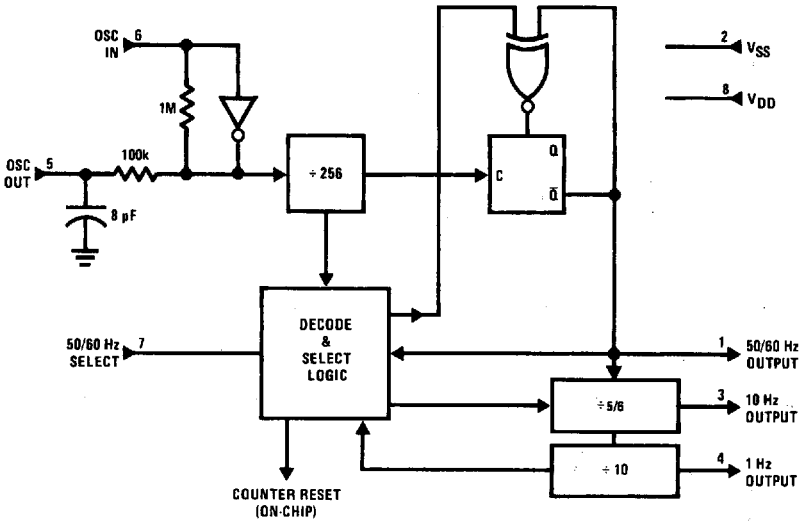
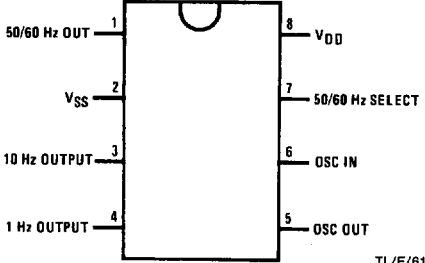


FIGURE 1

TL/F/6133-1

### Dual-In-Line Package



Top View  
FIGURE 2

TL/F/6133-2

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	$\mu A$
Operating Current Drain	$f_{IN} = 32 \text{ kHz}$ ; $V_{DD} = 3.5V$			60	$\mu A$
	$f_{IN} = 32 \text{ kHz}$ ; $V_{DD} = 15V$			1500	$\mu A$
Maximum Input Frequency	$V_{DD} = 3.5V$			64	kHz
	$V_{DD} = 15V$			500	kHz
Output Current Levels Logical "1", Source Logical "0", Sink	$V_{DD} = 5V$ $V_{OH} = V_{SS} + 2.7V$ $V_{OL} = V_{SS} + 0.4V$ $V_{DD} = 9V$	400		-400	$\mu A$
	$V_{OH} = V_{SS} + 6.7V$ $V_{OL} = V_{SS} + 0.4V$			-1500	$\mu A$
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	$\mu A$
	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	$\mu A$
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  $\mu A$  and current sunk by the input must be limited to 1.0  $\mu A$  for  $V_{DD} = 3.5V$ .

## Timing Diagrams

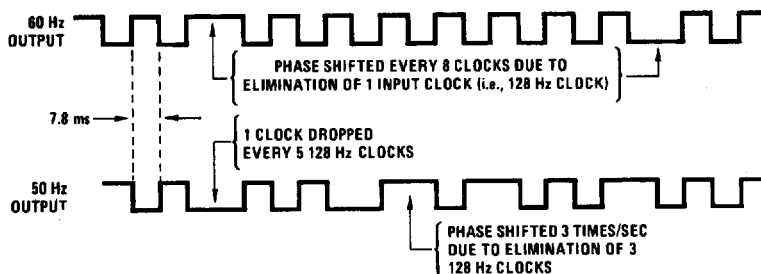
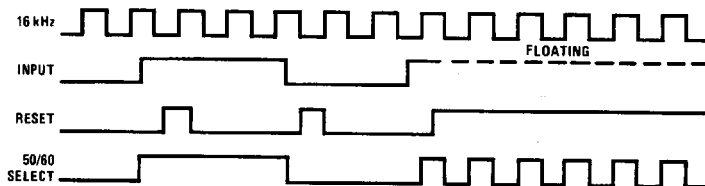


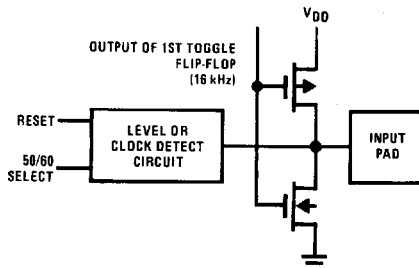
FIGURE 3. 50/60 Hz Output

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## Timing Diagrams (Continued)



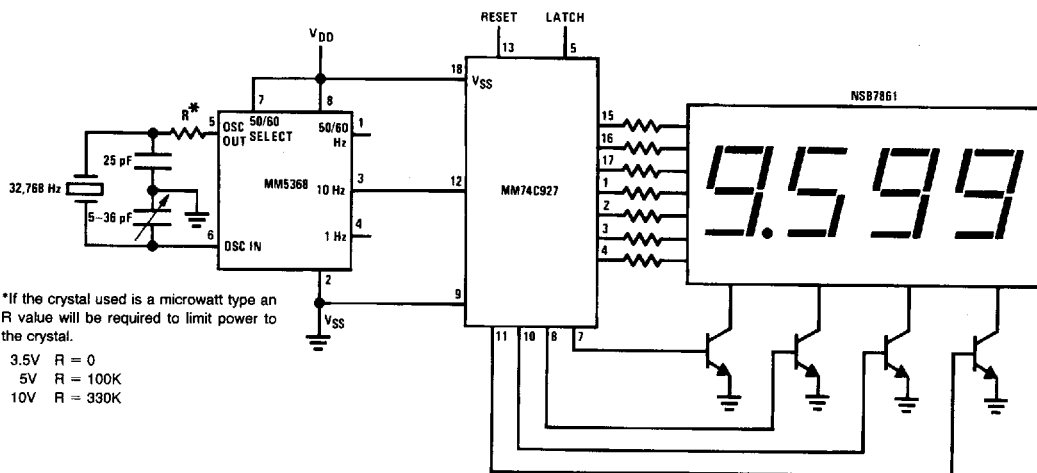
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FIGURE 4. 50/60 Select and Reset

## 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