

## AY-5-1224A

# **4 Digit Clock Circuit**

#### **FEATURES**

- 12/24 hour operation.
- Leading zero blanking in 12 hour mode.
- 50 or 60 Hz clock input.
- Hours and minutes display (4 digits).
- 7 segment outputs direct LED drive or TTL compatible BCD outputs.
- Complement control for segment outputs.
- Interdigit blanking for gas discharge displays.
- On chip multiplex oscillator.
- Single 15V supply.
- Power-On Reset to zero. (Counting does not start until time is set.)

### DESCRIPTION

The AY-5-1224A is a P channel MOS integrated circuit containing all the logic necessary to make a 4 digit, 12 or 24 hour clock operating from a 50 or 60Hz input. It has multiplexed BCD or 7-segment outputs and will drive LED, Fluorescent and Gas discharge displays with the minimum of interfacing.

### **PIN FUNCTIONS**

Pins 1 and 11 are multifunction. During multiplex times 1 to 4 they function as data outputs, either 7 segment code or BCD according to the display mode selected. During multiplex time 5 (Strobe) they function as inputs.

## Segment Outputs A-G (Pins 1 and 11 to 16)

In 7 segment mode the digits are multiplexed out on to these pins. Normally the outputs are at logic '0' (positive to display). Interdigit blanking for ¼ the digit time is incorporated for gas discharge displays.

### BCD Outputs 20-23 (Pins 1, 16, 15, 14)

In BCD mode the digits are multiplexed on to these pins in BCD code. Normally the outputs are at logic '0' (positive), i.e. code 0=0000.

# Multiplex Outputs 1-4 (Pins 10, 9, 8, 7)

These pins are successively switched to logic '0' to select appropriate digit display. A fifth multiplex time (Strobe) is used to enable the control inputs. These outputs have interdigit blanking. The multiplex rate is 1/20th the multiplex clock frequency.

# Strobe Output (Pin 6)

This pin is used to enable the control input keyboard, it goes to logic '0' to enable.

#### Set Hours Input (Pin 1)

When taken to logic '0' during strobe time this input causes the hours counter to advance at the rate of 1 hour per second.

## Set Min Input (Pin 16)

When taken to logic '0' during strobe time this input causes the minutes counter to advance at the rate of 1 per second and the hours counter to advance at the rate of 1 hour per minute.

#### Reset Input (Pin 15)

When taken to logic '0' during strobe time this input causes the clock to reset to zero.

### Complement Input (Pin 14)

When left open the segments and BCD outputs will have normal polarity. When connected to Strobe output via a diode the 7 segment and BCD outputs will be inverted.

# PIN CONFIGURATION 16 LEAD DUAL IN LINE Seg A Out/2° Out/Set Hrs in □ •1 16 Seg B Out/21 Out/Set Minutes Input Vss 🗆 2 15 Seg C Out/22 Out/Reset Input Multiplex Oscillator 14 Seg D Out/23 Out/Complement Input 50/60Hz Input 13 Seg E Out/12 or 24 Hr Select Vgg 🗆 12 Seg F Out/50 or 60Hz Select Strobe Output | 6 11 Seg G Out/BCD or 7 Seg Select MX 4 Output (Tens Hours) 10 MX1 Output (Units Minutes) MX 3 Output (Units Hours) 9 MX2 Output (Tens Minutes) **BLOCK DIAGRAM**

#### 12/24 Hour Select (Pin 13)

When left open the clock will run in the 12 hour mode, when connected to strobe via a diode 24 hour operation will result.

# 50/60Hz Select (Pin 12)

When left open a 50Hz clock will be accepted. When connected to strobe via a diode 60Hz operation will result.

#### BCD/7 Segment Select (Pin 11)

When left open 7 segment outputs will be provided, when connected to strobe via a diode BCD outputs will be provided.

#### 50/60Hz Input (Pin 4)

The master clock (50 or 60Hz) is input to this pin. Hysteresis is provided on the input so that the input wave form is not critical.

#### Multiplex Oscillator (Pin 3)

An external capacitor is used to set the multiplex frequency. If required this input can be driven by an external oscillator.

### V<sub>SS</sub> (Pin 2)

Positive supply line nominally OV.

### V<sub>GG</sub> (Pin 5)

Negative supply line nominally -15V.

#### Power-On Reset

At power-on the chip is reset to zero. Counters will not start until Set Hours or Set Minutes has been activated.

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# **ELECTRICAL CHARACTERISTICS**

# Maximum Ratings\*

Voltage on any pin with respect to $V_{ss}$	+0.3 to -20V
Operating Temperature Range	0° 10 +/0°C
Storage Temperature Range	C to +150°C
Power Dissipation at 70°C Ambient—Total	500mW
Per Output	50mW

\*Exceeding these ratings could cause permanent damage. Functional operation of this device at these conditions is not implied—operating ranges are specified below.

# Standard Conditions (unless otherwise noted)

 $V_{\text{SS}} = 0 V$  $V_{\rm GG} = -12$  to -18V

Operating Temperature (T<sub>A</sub>) =  $0^{\circ}$ C to  $+70^{\circ}$ C

Characteristic	Min	Тур**	Max	Units	Conditions
Clock input frequency	DC	50/60		Hz	_
Clock input logic '0'	+0.5	_	-2	Volts	Note 1
Clock input logic '1'	-8	_	V <sub>DD</sub>	Volts	_
Multiplex Clock Frequency	DC	_	50	KHz	Note 2
Interdigit Blanking		150	_ <del></del>	μS	at 6.67 KHz Note 3
Control inputs logic '0'	+0.3	_	-1.5	Volts	_
Control inputs logic '1'	-6	_	V <sub>DD</sub>	Volts	_
Outputs Logic '0'	_	_	500	Ohms	$\begin{cases} V_{OUT} = -2V \\ I_{OUT} = 4mA \end{cases}$
Outputs Logic '1' (Leakage)		_	10	μΑ	$V_{OUT} = -18V$
Supply Current	_	_	10	mA	V <sub>GG</sub> = -15V

<sup>\*\*</sup>Typical values are at +25°C and nominal voltages.

## NOTES:

- 1. The clock input pin may be taken position with respect to  $V_{ss}$  provided that the current is limited to  $100\mu A$ . The input will behave like a forward biased silicon diode in this condition.
- 2. The frequency is determined by an external capacitor.
- 3. At 6.67KHz multiplex frequency the digit ON time is 450  $\mu$ S and the OFF time is 150  $\mu$ S.

