



# 8224 CLOCK GENERATOR AND DRIVER FOR 8080A CPU

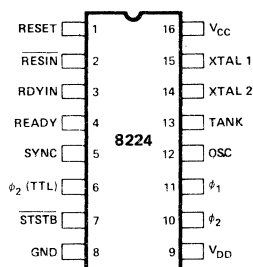
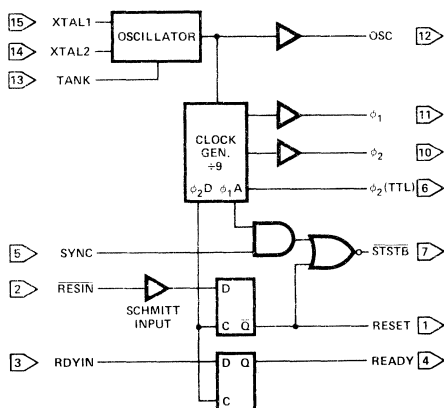
- Single Chip Clock Generator/Driver for 8080A CPU
- Power-Up Reset for CPU
- Ready Synchronizing Flip-Flop
- Advanced Status Strobe
- Oscillator Output for External System Timing
- Crystal Controlled for Stable System Operation
- Reduces System Package Count
- Available in EXPRESS - Standard Temperature Range
- Available in 16-Lead Cerdip Package

(See Packaging Spec, Order #231369)

The Intel® 8224 is a single chip clock generator/driver for the 8080A CPU. It is controlled by a crystal, selected by the designer to meet a variety of system speed requirements.

Also included are circuits to provide power-up reset, advance status strobe, and synchronization of ready.

The 8224 provides the designer with a significant reduction of packages used to generate clocks and timing for 8080A.



|       |                         |
|-------|-------------------------|
| RESIN | RESET INPUT             |
| RESET | RESET OUTPUT            |
| RDYIN | READY INPUT             |
| READY | READY OUTPUT            |
| SYNC  | SYNC INPUT              |
| STSTB | STATUS STB (ACTIVE LOW) |
| phi_1 | 8080                    |
| phi_2 | CLOCKS                  |

|             |                         |
|-------------|-------------------------|
| XTAL 1      | CONNECTIONS FOR CRYSTAL |
| XTAL 2      |                         |
| TANK        | USED WITH OVERTONE XTAL |
| OSC         | OSCILLATOR OUTPUT       |
| phi_2 (TTL) | phi_2 CLK (TTL LEVEL)   |
| VCC         | +5V                     |
| VDD         | +12V                    |
| GND         | 0V                      |

Figure 1. Block Diagram

Figure 2. Pin Configuration

## ABSOLUTE MAXIMUM RATINGS\*

|                          |                 |
|--------------------------|-----------------|
| Temperature Under Bias   | 0°C to 70°C     |
| Storage Temperature      | -65°C to 150°C  |
| Supply Voltage, $V_{CC}$ | -0.5V to +7V    |
| Supply Voltage, $V_{DD}$ | -0.5V to +13.5V |
| Input Voltage            | -1.5V to +7V    |
| Output Current           | 100mA           |

**\*NOTICE:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## D.C. CHARACTERISTICS $(T_A = 0^\circ\text{C to } 70^\circ\text{C}, V_{CC} = +5.0\text{V} \pm 5\%, V_{DD} = +12\text{V} \pm 5\%)$

| Symbol          | Parameter                         | Limits     |      |      | Units         | Test Conditions                                                                                                    |
|-----------------|-----------------------------------|------------|------|------|---------------|--------------------------------------------------------------------------------------------------------------------|
|                 |                                   | Min.       | Typ. | Max. |               |                                                                                                                    |
| $I_F$           | Input Current Loading             |            |      | -.25 | mA            | $V_F = .45\text{V}$                                                                                                |
| $I_R$           | Input Leakage Current             |            |      | 10   | $\mu\text{A}$ | $V_R = 5.25\text{V}$                                                                                               |
| $V_C$           | Input Forward Clamp Voltage       |            |      | 1.0  | V             | $I_C = -5\text{mA}$                                                                                                |
| $V_{IL}$        | Input "Low" Voltage               |            |      | .8   | V             | $V_{CC} = 5.0\text{V}$                                                                                             |
| $V_{IH}$        | Input "High" Voltage              | 2.6<br>2.0 |      |      | V             | Reset Input<br>All Other Inputs                                                                                    |
| $V_{IH}-V_{IL}$ | RESIN Input Hysteresis            | .25        |      |      | V             | $V_{CC} = 5.0\text{V}$                                                                                             |
| $V_{OL}$        | Output "Low" Voltage              |            |      | .45  | V             | $(\phi_1, \phi_2)$ , Ready, Reset, STSTB<br>$I_{OL} = 2.5\text{mA}$<br>All Other Outputs<br>$I_{OL} = 15\text{mA}$ |
|                 |                                   |            |      | .45  | V             |                                                                                                                    |
| $V_{OH}$        | Output "High" Voltage             | 9.4        |      |      | V             | $I_{OH} = -100\mu\text{A}$                                                                                         |
|                 | $\phi_1, \phi_2$                  | 3.6        |      |      | V             | $I_{OH} = -100\mu\text{A}$                                                                                         |
|                 | READY, RESET<br>All Other Outputs | 2.4        |      |      | V             | $I_{OH} = -1\text{mA}$                                                                                             |
| $I_{CC}$        | Power Supply Current              |            |      | 115  | mA            |                                                                                                                    |
| $I_{DD}$        | Power Supply Current              |            |      | 12   | mA            |                                                                                                                    |

Note: 1. For crystal frequencies of 18 MHz connect 510  $\Omega$  registers between the X1 input and ground as well as the X2 input and ground to prevent oscillation at harmonic frequencies.

## Crystal Requirements

Tolerance: 0.005% at 0°C-70°C  
 Resonance: Series (Fundamental)\*  
 Load Capacitance: 20-35 pF  
 Equivalent Resistance: 75-20 ohms  
 Power Dissipation (Min): 4 mW

\*With tank circuit use 3rd overtone mode.

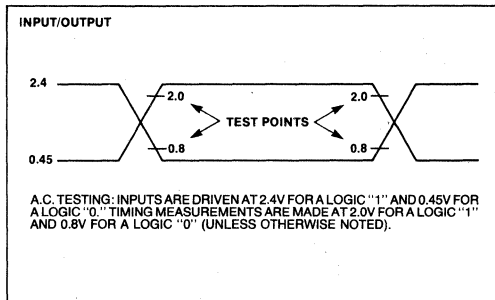
**A.C. CHARACTERISTICS** ( $V_{CC} = +5.0V \pm 5\%$ ,  $V_{DD} = +12.0V \pm 5\%$ ,  $T_A = 0^\circ C$  to  $70^\circ C$ )

| Symbol        | Parameter                                | Limits                  |                 |                         | Units | Test Conditions                                                |
|---------------|------------------------------------------|-------------------------|-----------------|-------------------------|-------|----------------------------------------------------------------|
|               |                                          | Min.                    | Typ.            | Max.                    |       |                                                                |
| $t_{\phi 1}$  | $\phi_1$ Pulse Width                     | $\frac{2tcy}{9} - 20ns$ |                 |                         | ns    | $C_L = 20pF$ to $50pF$                                         |
| $t_{\phi 2}$  | $\phi_2$ Pulse Width                     | $\frac{5tcy}{9} - 35ns$ |                 |                         |       |                                                                |
| $t_{D1}$      | $\phi_1$ to $\phi_2$ Delay               | 0                       |                 |                         |       |                                                                |
| $t_{D2}$      | $\phi_2$ to $\phi_1$ Delay               | $\frac{2tcy}{9} - 14ns$ |                 |                         |       |                                                                |
| $t_{D3}$      | $\phi_1$ to $\phi_2$ Delay               | $\frac{2tcy}{9}$        |                 | $\frac{2tcy}{9} + 20ns$ |       |                                                                |
| $t_R$         | $\phi_1$ and $\phi_2$ Rise Time          |                         |                 | 20                      |       |                                                                |
| $t_F$         | $\phi_1$ and $\phi_2$ Fall Time          |                         |                 | 20                      |       |                                                                |
| $t_{D\phi 2}$ | $\phi_2$ to $\phi_2$ (TTL) Delay         | -5                      |                 | +15                     | ns    | $\phi_2$ TTL, $C_L=30$<br>$R_1=300\Omega$<br>$R_2=600\Omega$   |
| $t_{DSS}$     | $\phi_2$ to $\overline{STSTB}$ Delay     | $\frac{6tcy}{9} - 30ns$ |                 | $\frac{6tcy}{9}$        |       | $\overline{STSTB}$ , $C_L=15pF$<br>$R_1 = 2K$<br>$R_2 = 4K$    |
| $t_{PW}$      | $\overline{STSTB}$ Pulse Width           | $\frac{tcy}{9} - 15ns$  |                 |                         |       |                                                                |
| $t_{DRS}$     | RDYIN Setup Time to Status Strobe        | $50ns - \frac{4tcy}{9}$ |                 |                         |       |                                                                |
| $t_{DRH}$     | RDYIN Hold Time After $\overline{STSTB}$ | $\frac{4tcy}{9}$        |                 |                         |       |                                                                |
| $t_{DR}$      | RDYIN or RESIN to $\phi_2$ Delay         | $\frac{4tcy}{9} - 25ns$ |                 |                         |       | Ready & Reset<br>$C_L=10pF$<br>$R_1=2K$<br>$R_2=4K$            |
| $t_{CLK}$     | CLK Period                               |                         | $\frac{tcy}{9}$ |                         |       |                                                                |
| $f_{max}$     | Maximum Oscillating Frequency            |                         |                 | 27                      | MHz   |                                                                |
| $C_{in}$      | Input Capacitance                        |                         |                 | 8                       | pF    | $V_{CC}=+5.0V$<br>$V_{DD}=+12V$<br>$V_{BIAS}=2.5V$<br>$f=1MHz$ |

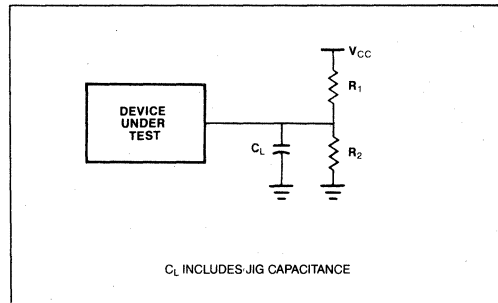
**A.C. CHARACTERISTICS (Continued)** (For  $t_{CY} = 488.28 \text{ ns}$  ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{DD} = +5V \pm 5\%$ ,  $V_{DD} = +12V \pm 5\%$ ))

| Symbol        | Parameter                                       | Limits |      |        | Units | Test Conditions                                                                                                              |
|---------------|-------------------------------------------------|--------|------|--------|-------|------------------------------------------------------------------------------------------------------------------------------|
|               |                                                 | Min.   | Typ. | Max.   |       |                                                                                                                              |
| $t_{\phi 1}$  | $\phi_1$ Pulse Width                            | 89     |      |        | ns    | $t_{CY}=488.28\text{ns}$<br><br>$\phi_1$ & $\phi_2$ Loaded to $C_L = 20$ to $50\text{pF}$                                    |
| $t_{\phi 2}$  | $\phi_2$ Pulse Width                            | 236    |      |        | ns    |                                                                                                                              |
| $t_{D1}$      | Delay $\phi_1$ to $\phi_2$                      | 0      |      |        | ns    |                                                                                                                              |
| $t_{D2}$      | Delay $\phi_2$ to $\phi_1$                      | 95     |      |        | ns    |                                                                                                                              |
| $t_{D3}$      | Delay $\phi_1$ to $\phi_2$ Leading Edges        | 109    |      | 129    | ns    |                                                                                                                              |
| $t_r$         | Output Rise Time                                |        |      | 20     | ns    |                                                                                                                              |
| $t_f$         | Output Fall Time                                |        |      | 20     | ns    |                                                                                                                              |
| $t_{DSS}$     | $\phi_2$ to $\overline{\text{STSTB}}$ Delay     | 296    |      | 326    | ns    |                                                                                                                              |
| $t_{D\phi 2}$ | $\phi_2$ to $\phi_2$ (TTL) Delay                | -5     |      | +15    | ns    |                                                                                                                              |
| $t_{PW}$      | Status Strobe Pulse Width                       | 40     |      |        | ns    |                                                                                                                              |
| $t_{DRS}$     | RDYIN Setup Time to $\overline{\text{STSTB}}$   | -167   |      |        | ns    | Ready & Reset Loaded to $2\text{mA}/10\text{pF}$<br>All measurements referenced to $1.5\text{V}$ unless specified otherwise. |
| $t_{DRH}$     | RDYIN Hold Time after $\overline{\text{STSTB}}$ | 217    |      |        | ns    |                                                                                                                              |
| $t_{DR}$      | READY or RESET to $\phi_2$ Delay                | 192    |      |        | ns    |                                                                                                                              |
| $f_{MAX}$     | Oscillator Frequency                            |        |      | 18.432 | MHz   |                                                                                                                              |

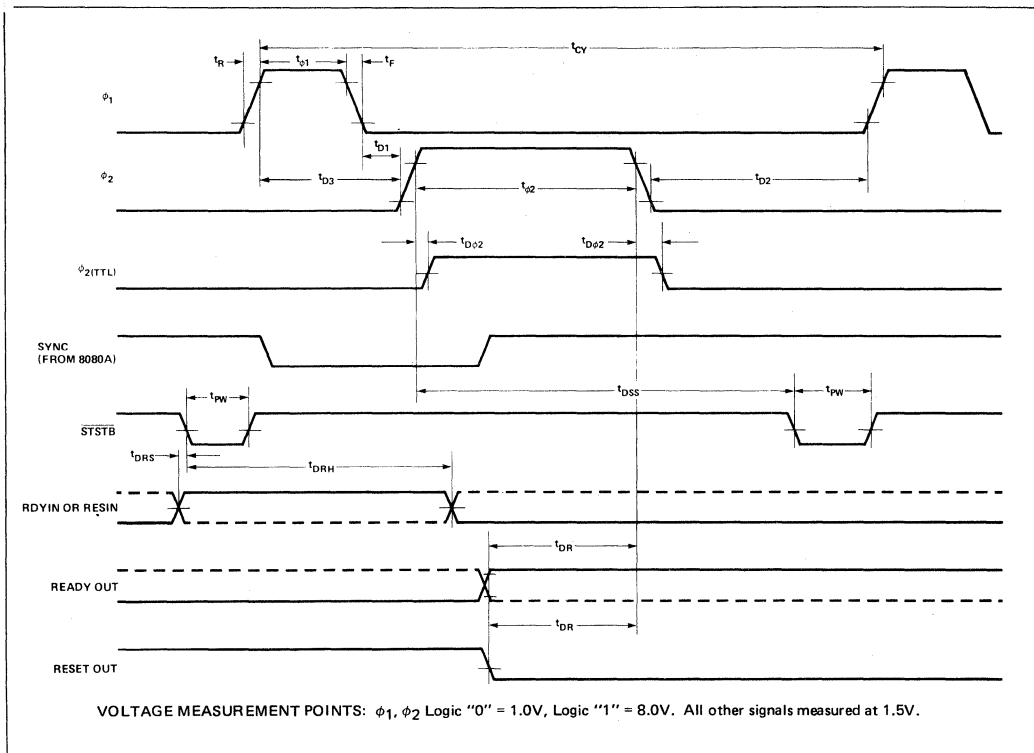
**A.C. TESTING INPUT, OUTPUT WAVEFORM**



**A.C. TESTING LOAD CIRCUIT**



# WAVEFORMS



## CLOCK HIGH AND LOW TIME (USING X1, X2)

