



## DP8224 Clock Generator and Driver

### General Description

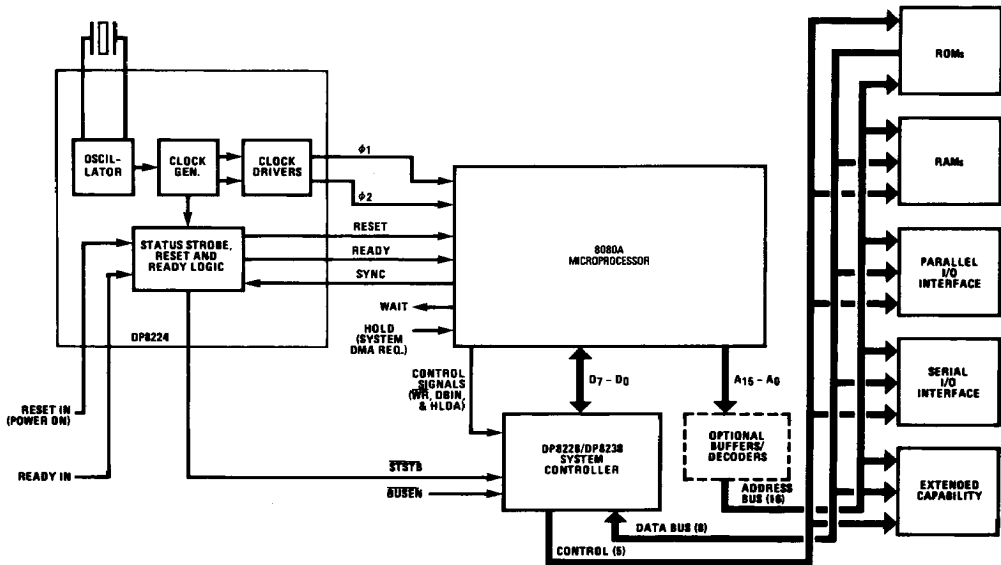
The DP8224 is a clock generator/driver contained in a standard, 16-pin dual-in-line package. The chip, which is fabricated using Schottky Bipolar technology, generates clocks and timing for the 8080A microcomputer family.

Included in the DP8224 is an oscillator circuit that is controlled by an external crystal, which is selected by the designer to meet a variety of system speed requirements. Also included in the chip are circuits that provide: a status strobe for the DP8228 or DP8238 system controllers, power-on reset for the 8080A microprocessor, and synchronization of the READY input to the 8080A.

### Features

- Crystal-controlled oscillator for stable system operation
- Single chip clock generator and driver for 8080A microprocessor
- Provides status strobe for DP8228 or DP8238 system controllers
- Provides power-on reset for 8080A microprocessor
- Synchronizes READY input to 8080A microprocessor
- Provides oscillator output for synchronization of external circuits
- Reduces system component count

### 8080A Microcomputer Family Block Diagram



TL/F/8752-1

**Absolute Maximum Ratings** (Note 2)

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

Supply Voltage	
V <sub>CC</sub>	7V
V <sub>DD</sub>	15V
Input Voltage	-1V to +5.5V
Storage Temperature Range	-65°C to +150°C
Maximum Power Dissipation* at 25°C	
Cavity Package	1509 mW
Molded Package	1476 mW
Lead Temperature (Soldering, 4 seconds)	260°C

\* Derate cavity package 10.1 mW/°C above 25°C; derate molded package 11.8 mW/°C above 25°C.

**Operating Conditions**

	Min	Max	Units
Supply Voltage			
V <sub>CC</sub>	4.75	5.25	V
V <sub>DD</sub>	11.4	12.6	V
Temperature (T <sub>A</sub> )	0	+70	°C

**Electrical Characteristics** (Note 3)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I <sub>F</sub>	Input Current Loading	V <sub>F</sub> = 0.45V			-0.25	mA
I <sub>R</sub>	Input Leakage Current	V <sub>R</sub> = 5.25V			10	μA
V <sub>C</sub>	Input Forward Clamp Voltage	I <sub>C</sub> = -5 mA			-1.0	V
V <sub>IL</sub>	Input "Low" Voltage	V <sub>CC</sub> = 5V			0.8	V
V <sub>IH</sub>	Input "High" Voltage	RESIN Input	2.6			V
		All Other Inputs	2.0			V
V <sub>IH</sub> - V <sub>IL</sub>	RESIN Input Hysteresis	V <sub>CC</sub> = 5V	0.25			V
V <sub>OL</sub>	Output "Low" Voltage (φ1, φ2), Ready, Reset <u>STSTB</u> Osc., φ2 (TTL) Osc., φ2 (TTL)	I <sub>OL</sub> = 2.5 mA			0.45	V
		I <sub>OL</sub> = 10 mA			0.45	V
		I <sub>OL</sub> = 15 mA			0.45	V
V <sub>OH</sub>	Output "High" Voltage φ1, φ2 Ready, Reset Osc., φ2 (TTL), <u>STSTB</u>	I <sub>OH</sub> = -100 μA	9.4			V
		I <sub>OH</sub> = -100 μA	3.6			V
		I <sub>OH</sub> = -1 mA	2.4			V
I <sub>SC</sub>	Output Short-Circuit Current (All Low Voltage Outputs Only), (Note 1)	V <sub>O</sub> = 0V, V <sub>CC</sub> = 5V	-10		-60	mA
I <sub>CC</sub>	Power Supply Current				115	mA
I <sub>DD</sub>	Power Supply Current				12	mA

**Note 1:** Caution - φ1 and φ2 output drivers do not have short circuit protection.

**Note 2:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 3:** Unless otherwise specified min/max limits apply across the 0°C to +70°C range for the DP8224. All typical values are for T<sub>A</sub> = 25°C, V<sub>CC</sub> = 5V, and V<sub>DD</sub> = 12V.

**Crystal Requirements\***

Tolerance	0.005% at 0°C to +70°C	Equivalent Resistance	75Ω to 20Ω
Resonance	Fundamental	Power Dissipation (Min)	4 mW
Load Capacitance	20 pF to 30 pF		

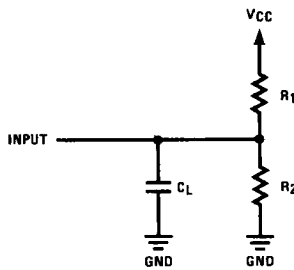
\*It is good design practice to ground the case of the crystal

\*\*With tank circuit, use 3rd overtone mode

## Switching Characteristics (Note 3)

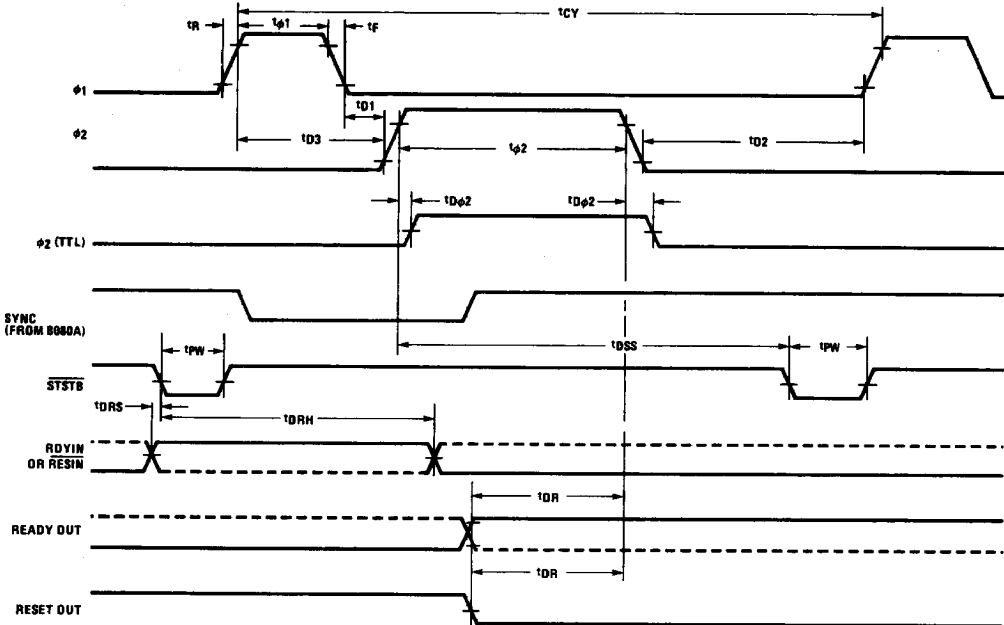
Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{\phi 1}$	$\phi 1$ Pulse Width	$C_L = 20 \text{ pF}$ to $50 \text{ pF}$	$\frac{2t_{CY}}{9} - 20$			ns
$t_{\phi 2}$	$\phi 2$ Pulse Width		$\frac{5t_{CY}}{9} - 35$			ns
$t_{D1}$	$\phi 1$ to $\phi 2$ Delay		0			ns
$t_{D2}$	$\phi 2$ to $\phi 1$ Delay		$\frac{2t_{CY}}{9} - 14$			ns
$t_{D3}$	$\phi 1$ to $\phi 2$ Delay		$\frac{2t_{CY}}{9}$		$\frac{2t_{CY}}{9} + 20$	ns
$t_r$	$\phi 1$ and $\phi 2$ Rise Time				20	ns
$t_f$	$\phi 1$ and $\phi 2$ Fall Time				20	ns
$t_{D\phi 2}$	$\phi 2$ to $\phi 2$ (TTL) Delay	$\phi 2$ TTL, $C_L = 30 \text{ pF}$ , $R_1 = 300\Omega$ , $R_2 = 600\Omega$	-5		15	ns
$t_{DSS}$	$\phi 2$ to $\overline{STSTB}$ Delay	$\overline{STSTB}$ , $C_L = 15 \text{ pF}$ $R_1 = 2 \text{ k}\Omega$ , $R_2 = 4 \text{ k}\Omega$	$\frac{6t_{CY}}{9} - 30$		$\frac{6t_{CY}}{9}$	ns
$t_{PW}$	$\overline{STSTB}$ Pulse Width		$\frac{t_{CY}}{9} - 15$			ns
$t_{DRS}$	RDYIN Set-Up Time to Status Strobe		$50 - \frac{4t_{CY}}{9}$			ns
$t_{DRH}$	RDYIN Hold Time After $\overline{STSTB}$		$\frac{4t_{CY}}{9}$			ns
$t_{DR}$	READY or RESET to $\phi 2$ Delay	Ready and Reset, $C_L = 10 \text{ pF}$ , $R_1 = 2 \text{ k}\Omega$ , $R_2 = 4 \text{ k}\Omega$	$\frac{4t_{CY}}{9} - 25$			ns
$t_{CLK}$	CLK Period			$\frac{t_{CY}}{9}$		ns
$f_{MAX}$	Maximum Oscillating Frequency		27			MHz
$C_{IN}$	Input Capacitance	$V_{CC} = 5V$ , $V_{DD} = 12V$ , $V_{BIAS} = 2.5V$ , $f = 1 \text{ MHz}$			8	pF

### Test Circuit



TL/F/8752-2

# Waveforms



TL/F/6752-3

Voltage Measurement Points:  $\phi 1, \phi 2$  Logic "0" = 1.0V, Logic "1" = 8.0V. All other signals measured at 1.5V.

## Switching Characteristics (For $t_{CY} = 488.28$ ns)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{\phi 1}$	$\phi 1$ Pulse Width	$\phi 1$ and $\phi 2$ Loaded to $C_L = 20$ to $50$ pF Ready and Reset Loaded to $2$ mA/ $10$ pF All Measurements Referenced to $1.5$ V unless Specified Otherwise	89			ns
$t_{\phi 2}$	$\phi 2$ 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 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 Set-Up Time to STSTB		-167			ns
$t_{DRH}$	RDYIN Hold Time after STSTB		217			ns
$t_{DR}$	READY or RESET to $\phi 2$ Delay		192			ns
$f_{MAX}$	Oscillator Frequency				18.432	MHz

## Functional Pin Definitions

The following describes the function of all of the DP8224 input/output pins. Some of these descriptions reference internal circuits.

### INPUT SIGNALS

**Crystal Connections (XTAL 1 and XTAL 2):** Two inputs that connect an external crystal to the oscillator circuit of the DP8224. Normally, a fundamental mode crystal is used to determine the basic operating frequency of the oscillator. However, overtone mode crystals may also be used. The crystal frequency is 9 times the desired microprocessor speed (that is, crystal frequency equals  $1/T_{CY} \times 9$ ). When the crystal frequency is above 10 MHz, a selected capacitor (3 to 10 pF) may have to be connected in series with the crystal to produce the exact desired frequency. *Figure A.*

**Tank:** Allows the use of overtone mode crystals with the oscillator circuit. When an overtone mode crystal is used, the tank input connects to a parallel LC network that is ac coupled to ground. The formula for determining the resonant frequency of this LC network is as follows:

$$F = \frac{1}{2\pi \sqrt{LC}}$$

**Synchronizing (SYNC) Signal:** When high, indicates the beginning of a new machine cycle. The 8080A microprocessor outputs a status word (which describes the current machine cycle) onto its data bus during the first state (SYNC interval) of each machine cycle.

**Reset In (RESIN):** Provides an automatic system reset and start-up upon application of power as follows. The RESIN input, which is obtained from the junction of an external RC network that is connected between  $V_{CC}$  and ground, is routed to an internal Schmitt Trigger circuit. This circuit converts the slow transition of the power supply rise into a sharp, clean edge when its input reaches a predetermined value. When this occurs, an internal D-type flip-flop is synchronously reset, thereby providing the RESET output signal discussed below.

For manual system reset, a momentary contact switch that provides a low (ground) when closed is also connected to the RESIN input.

**Ready In (RDYIN):** An asynchronous READY signal that is re-clocked by a D-type flip-flop of the DP8224 to provide the synchronous READY output discussed below.

+ 5 Volts:  $V_{CC}$  supply.

+ 12 Volts:  $V_{DD}$  supply.

Ground: 0 volt reference.

### OUTPUT SIGNALS

**Oscillator (OSC):** A buffered oscillator signal that can be used for external timing purposes.

**$\phi_1$  and  $\phi_2$  Clocks:** Two non-TTL compatible clock phases that provide nonoverlapping timing references for internal storage elements and logic circuits of the 8080A microprocessor. The two clock phases are produced by an internal clock generator that consists of a divide-by-nine counter and the associated decode gating logic. *Figure B.*

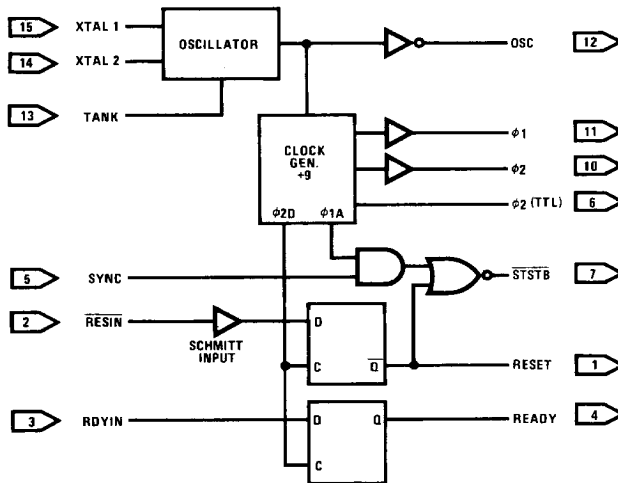
**$\phi_2$  (TTL) Clock:** A TTL  $\phi_2$  clock phase that can be used for external timing purposes.

**Status Strobe (STSTB):** Activated (low) at the start of each new machine cycle. The STSTB signal is generated by gating a high-level SYNC input with the  $\phi_{1A}$  timing signal from the internal clock generator of the DP8224. The STSTB signal is used to clock status information into the status latch of the DP8228 system controller and bus driver.

**Reset:** When the RESET signal is activated, the content of the program counter of the 8080A is cleared. After RESET, the program will start at location 0 in memory.

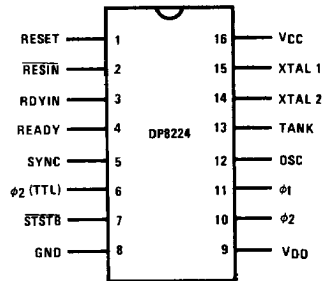
**Ready:** The READY signal indicates to the 8080A that valid memory or input data is available. This signal is used to synchronize the 8080A with slower memory or input/output devices.

## Logic and Connection Diagrams



TL/F/8752-4

### Dual-In-Line Package

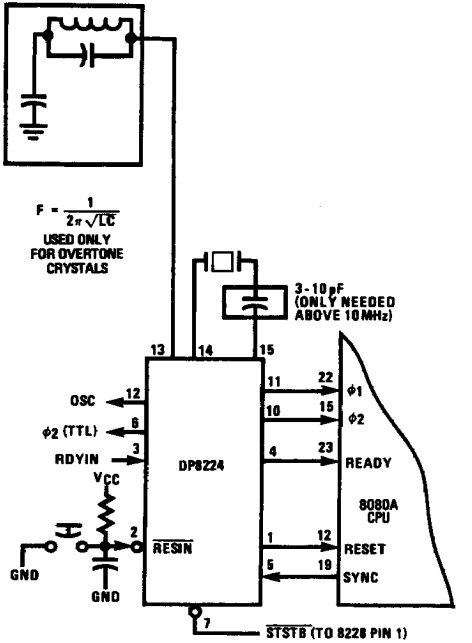


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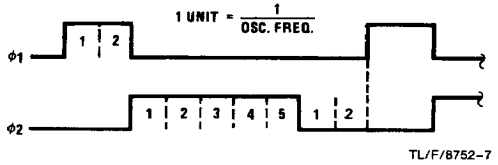
### Top View

Order Number DP8224J or DP8224N  
See NS Package Number  
J16A or N16A

**Applications Information**



**FIGURE A. DP8224 Connection Diagram**



EXAMPLE: (8080  $t_{CY} = 500$  ns)  
 OSC = 18 MHz/55 ns  
 $\phi_1 = 110$  ns ( $2 \times 55$  ns)  
 $\phi_2 = 275$  ns ( $5 \times 55$  ns)  
 $\phi_2 - \phi_1 = 110$  ns ( $2 \times 55$  ns)

**FIGURE B. DP8224 Clock Generator Waveforms**