

SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

SCAS204C – APRIL 1992 – REVISED APRIL 1998

- Member of the Texas Instruments Widebus™ Family
- Load Clock and Unload Clock Can Be Asynchronous or Coincident
- 512 Words by 18 Bits
- Low-Power Advanced CMOS Technology
- Full, Empty, and Half-Full Flags
- Programmable Almost-Full/Almost-Empty Flag
- Fast Access Times of 15 ns With a 50-pF Load and All Data Outputs Switching Simultaneously
- Data Rates up to 50 MHz
- 3-State Outputs
- Pin-to-Pin Compatible With SN74ACT7806 and SN74ACT7814
- Packaged in Shrink Small-Outline 300-mil Package Using 25-mil Center-to-Center Spacing

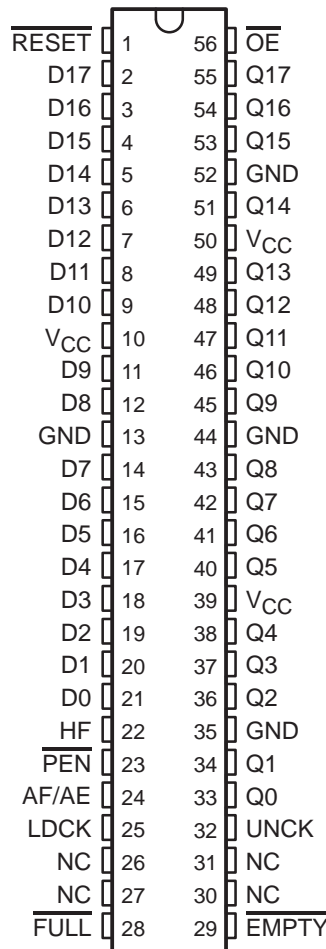
description

A FIFO memory is a storage device that allows data to be written into and read from its array at independent data rates. The SN74ACT7804 is a 512-word by 18-bit FIFO for high speed and fast access times. It processes data at rates up to 50 MHz and access times of 15 ns in a bit-parallel format.

Data is written into memory on a low-to-high transition at the load-clock (LDCK) input and is read out on a low-to-high transition at the unload-clock (UNCK) input. The memory is full when the number of words clocked in exceeds the number of words clocked out by 512. When the memory is full, LDCK signals have no effect on the data residing in memory. When the memory is empty, UNCK signals have no effect.

Status of the FIFO memory is monitored by the full ($\overline{\text{FULL}}$), empty ($\overline{\text{EMPTY}}$), half-full (HF), and almost-full/almost-empty (AF/AE) flags. The $\overline{\text{FULL}}$ output is low when the memory is full and high when the memory is not full. The $\overline{\text{EMPTY}}$ output is low when the memory is empty and high when it is not empty. The HF output is high when the FIFO contains 256 or more words. The AF/AE status flag is a programmable flag. The first one or two low-to-high transitions of LDCK after reset are used to program the almost-empty offset value (X) and the almost-full offset value (Y) if program enable ($\overline{\text{PEN}}$) is low. The AF/AE flag is high when the FIFO contains X or fewer words or (512 – Y) or more words. The AF/AE flag is low when the FIFO contains between (X + 1) and (511 – Y) words.

DL PACKAGE
(TOP VIEW)



NC – No internal connection



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Widebus is a trademark of Texas Instruments Incorporated.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1998, Texas Instruments Incorporated

SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

SCAS204C – APRIL 1992 – REVISED APRIL 1998

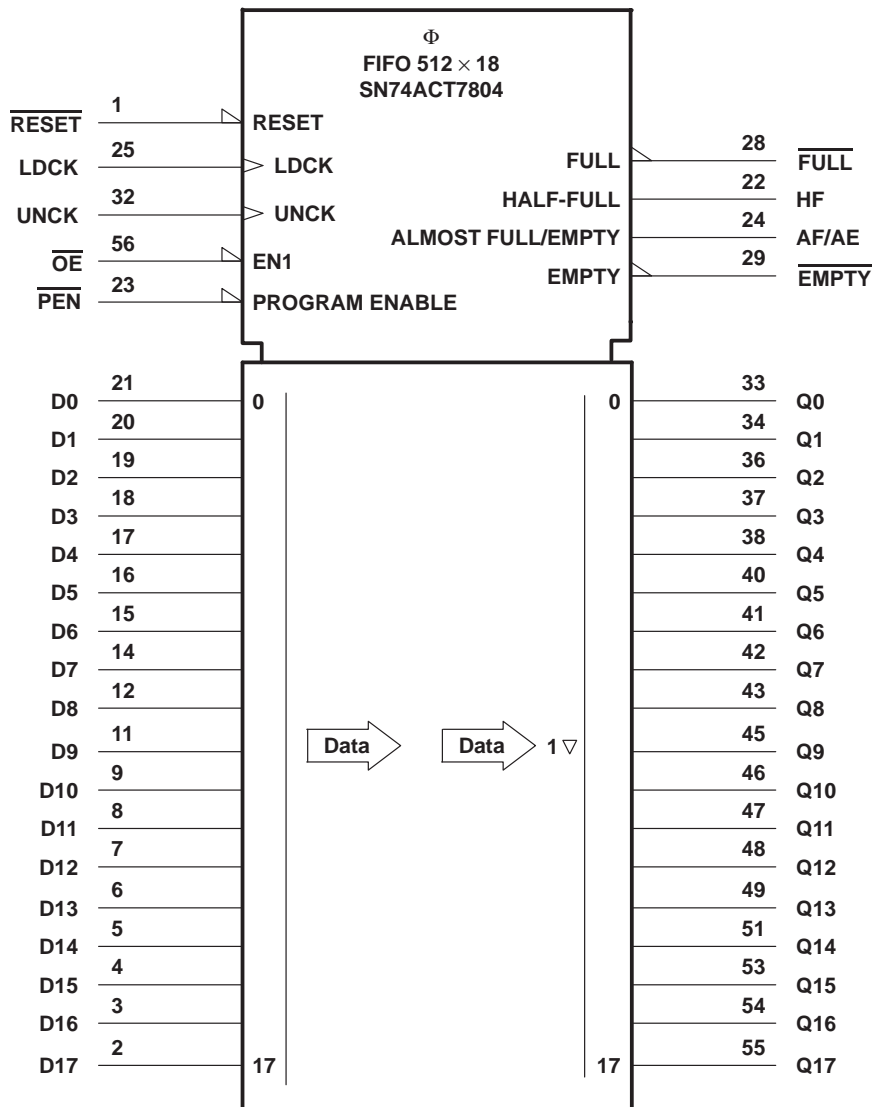
description (continued)

A low level on the reset ($\overline{\text{RESET}}$) input resets the internal stack pointers and sets $\overline{\text{FULL}}$ high, AF/AE high, HF low, and $\overline{\text{EMPTY}}$ low. The Q outputs are not reset to any specific logic level. The FIFO must be reset upon power up.

The first word loaded into empty memory causes $\overline{\text{EMPTY}}$ to go high and the data to appear on the Q outputs. It is important to note that the first word does not have to be unloaded. The data outputs are noninverting with respect to the data inputs and are in the high-impedance state when the output-enable ($\overline{\text{OE}}$) input is high.

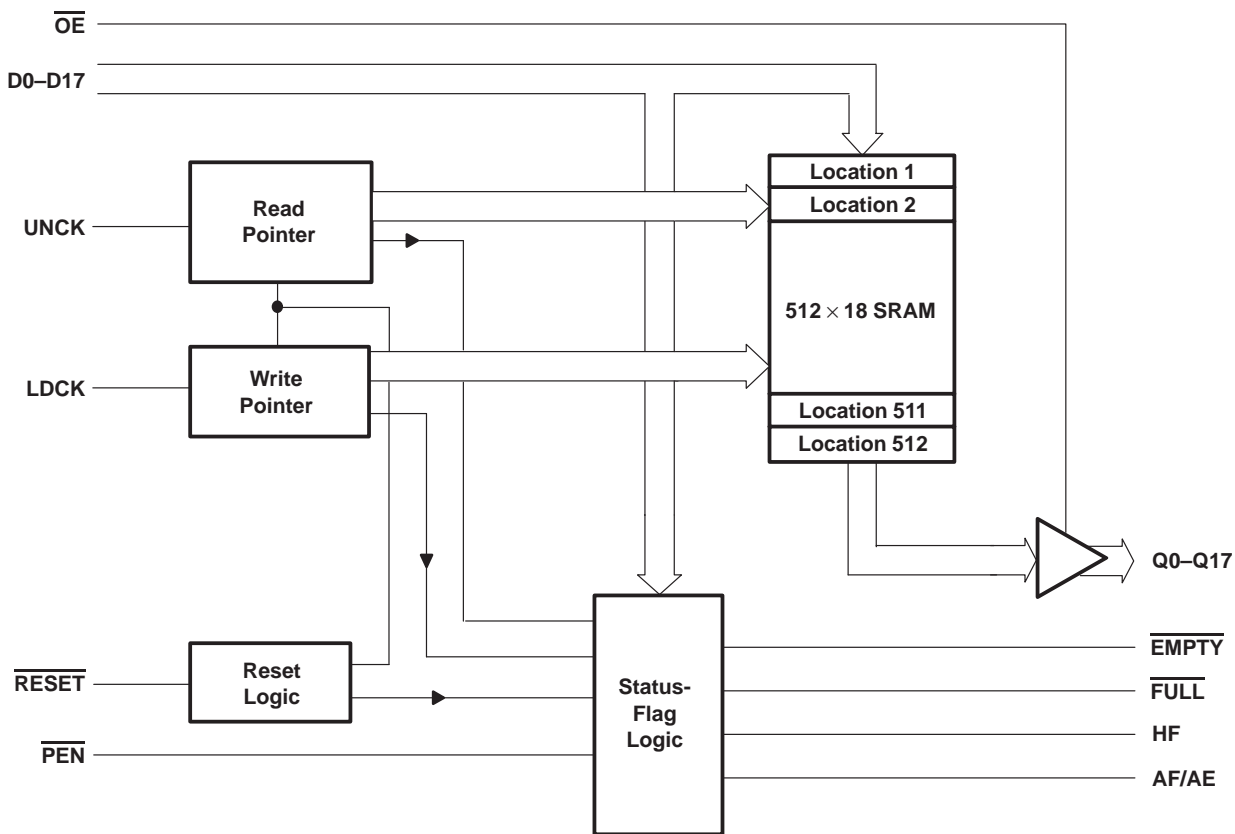
The SN74ACT7804 is characterized for operation from 0°C to 70°C.

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

functional block diagram



Terminal Functions

| TERMINAL NAME | NO. | I/O | DESCRIPTION |
|---------------------------|---------------------------------------|-----|--|
| AF/AE | 24 | O | Almost-full/almost-empty flag. Depth-offset values can be programmed for AF/AE, or the default value of 64 can be used for both the almost-empty offset (X) and the almost-full offset (Y). AF/AE is high when memory contains X or fewer words or (512 – Y) or more words. AF/AE is high after reset. |
| D0–D17 | 2–9, 11–12, 14–21 | I | 18-bit data input port |
| $\overline{\text{EMPTY}}$ | 29 | O | Empty flag. $\overline{\text{EMPTY}}$ is low when the FIFO is empty. A FIFO reset also causes $\overline{\text{EMPTY}}$ to go low. |
| $\overline{\text{FULL}}$ | 28 | O | Full flag. $\overline{\text{FULL}}$ is low when the FIFO is full. A FIFO reset causes $\overline{\text{FULL}}$ to go high. |
| HF | 22 | O | Half-full flag. HF is high when the FIFO memory contains 256 or more words. HF is low after reset. |
| LDCK | 25 | I | Load clock. Data is written to the FIFO on the rising edge of LDCK when $\overline{\text{FULL}}$ is high. |
| $\overline{\text{OE}}$ | 56 | I | Output enable. When $\overline{\text{OE}}$ is high, the data outputs are in the high-impedance state. |
| $\overline{\text{PEN}}$ | 23 | I | Program enable. After reset and before the first word is written to the FIFO, the binary value on D0–D7 is latched as an AF/AE offset value when $\overline{\text{PEN}}$ is low and LDCK is high. |
| Q0–Q17 | 33–34, 36–38, 40–43, 45–49, 51, 53–55 | O | 18-bit data output port |
| $\overline{\text{RESET}}$ | 1 | I | Reset. A low level on $\overline{\text{RESET}}$ resets the FIFO and drives AF/AE and $\overline{\text{FULL}}$ high and HF and $\overline{\text{EMPTY}}$ low. |
| UNCK | 32 | I | Unload clock. Data is read from the FIFO on the rising edge of UNCK when $\overline{\text{EMPTY}}$ is high. |

SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

SCAS204C – APRIL 1992 – REVISED APRIL 1998

offset values for AF/AE

The AF/AE flag has two programmable limits: the almost-empty offset value (X) and the almost-full offset value (Y). They can be programmed after the FIFO is reset and before the first word is written to memory. The AF/AE flag is high when the FIFO contains X or fewer words or (512 – Y) or more words.

To program the offset values, $\overline{\text{PEN}}$ can be brought low after reset only when LDCK is low. On the following low-to-high transition of LDCK, the binary value on D0–D7 is stored as the almost-empty offset value (X) and the almost-full offset value (Y). Holding $\overline{\text{PEN}}$ low for another low-to-high transition of LDCK reprograms Y to the binary value on D0–D7 at the time of the second LDCK low-to-high transition. Writes to the FIFO memory are disabled while the offsets are programmed. A maximum value of 255 can be programmed for either X or Y (see Figure 1). To use the default values of X = Y = 64, $\overline{\text{PEN}}$ must be held high.

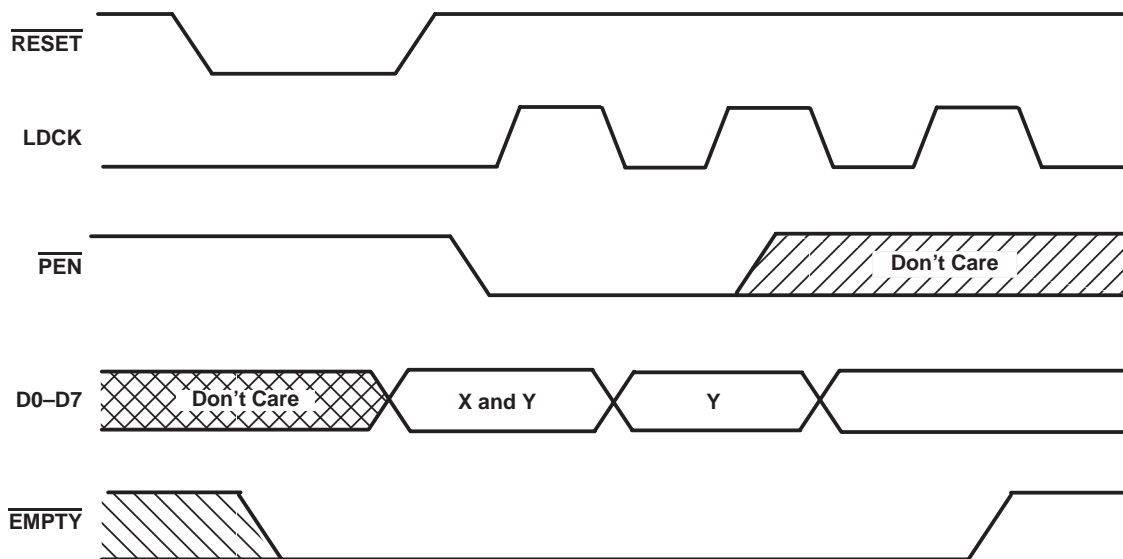
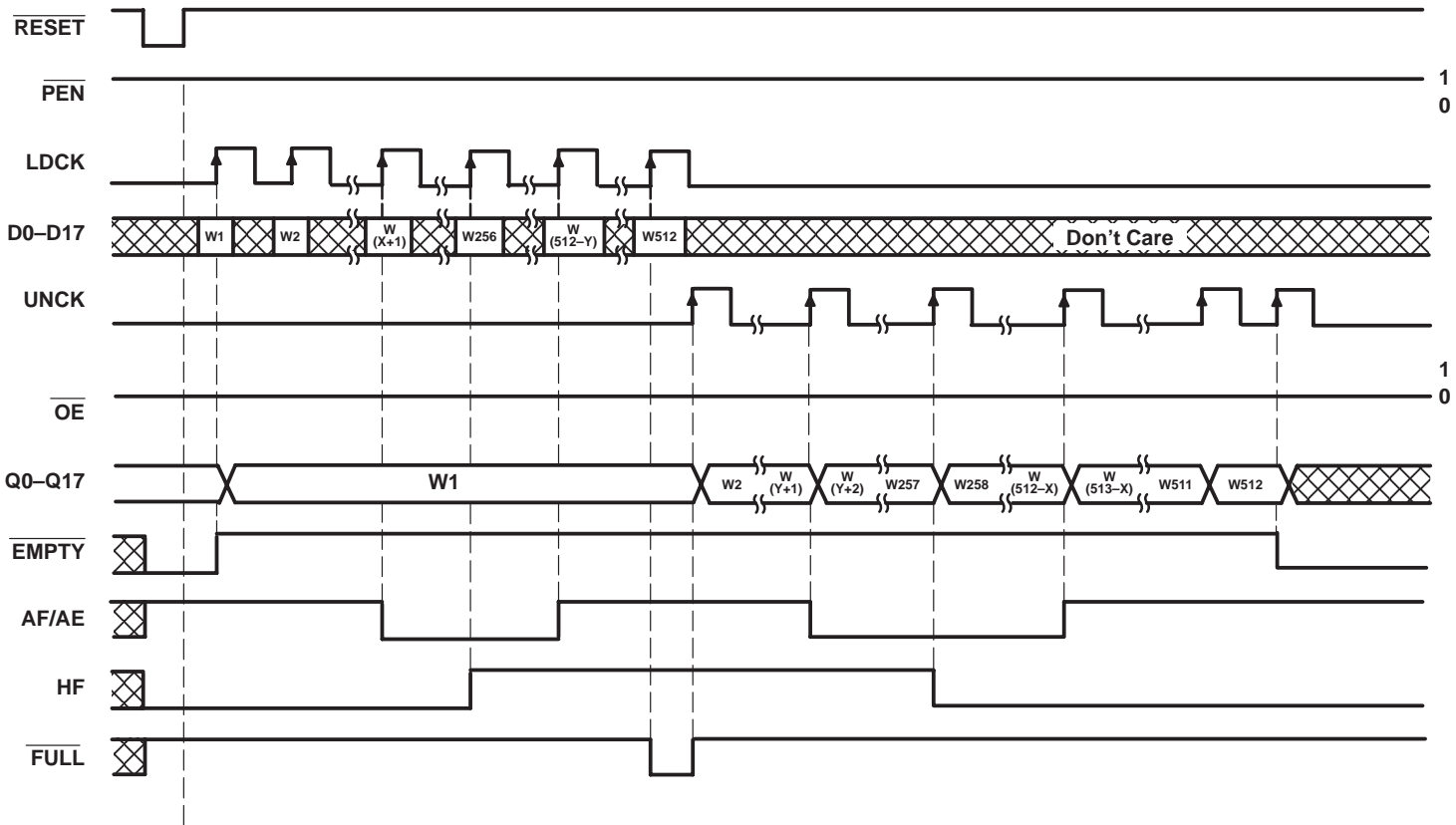


Figure 1. Programming X and Y Separately



Define the AF/AE Flag Using
 the Default Value of X and Y

Figure 2. Write, Read, and Flag Timing Reference

SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

SCAS204C – APRIL 1992 – REVISED APRIL 1998

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|---|-----------------|
| Supply voltage range, V_{CC} | -0.5 V to 7 V |
| Input voltage range, V_I | -0.5 V to 7 V |
| Voltage range applied to a disabled 3-state output | -0.5 V to 5.5 V |
| Package thermal impedance, θ_{JA} (see Note 1) | 74°C/W |
| Storage temperature range, T_{stg} | -65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions

| | | 'ACT7804-20 | | 'ACT7804-25 | | 'ACT7804-40 | | UNIT |
|----------|--------------------------------|-------------|-----|-------------|-----|-------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| V_{CC} | Supply voltage | 4.5 | 5.5 | 4.5 | 5.5 | 4.5 | 5.5 | V |
| V_{IH} | High-level input voltage | 2 | | 2 | | 2 | | V |
| V_{IL} | Low-level input voltage | | 0.8 | | 0.8 | | 0.8 | V |
| I_{OH} | High-level output current | | | | | | | |
| | Q outputs, flags | | -8 | | -8 | | -8 | mA |
| I_{OL} | Low-level output current | | | | | | | |
| | Q outputs | | 16 | | 16 | | 16 | mA |
| | Flags | | 8 | | 8 | | 8 | |
| T_A | Operating free-air temperature | 0 | 70 | 0 | 70 | 0 | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP‡ | MAX | UNIT |
|-------------------|---|-----|------|-----|------|
| V_{OH} | $V_{CC} = 4.5\text{ V}$, $I_{OH} = -8\text{ mA}$ | | 2.4 | | V |
| V_{OL} | Flags | | | 0.5 | V |
| | Q outputs | | | 0.5 | |
| I_I | $V_{CC} = 5.5\text{ V}$, $V_I = V_{CC}$ or 0 | | | ±5 | µA |
| I_{OZ} | $V_{CC} = 5.5\text{ V}$, $V_O = V_{CC}$ or 0 | | | ±5 | µA |
| I_{CC} | $V_{CC} = 5.5\text{ V}$, $V_I = V_{CC} - 0.2\text{ V}$ or 0 | | | 400 | µA |
| ΔI_{CC} § | $V_{CC} = 5.5\text{ V}$, One input at 3.4 V, Other inputs at V_{CC} or GND | | | 1 | mA |
| C_i | $V_I = 0$, $f = 1\text{ MHz}$ | | 4 | | pF |
| C_o | $V_O = 0$, $f = 1\text{ MHz}$ | | 8 | | pF |

‡ All typical values are at $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.

§ This is the supply current for each input that is at one of the specified TTL voltage levels rather 0 V or V_{CC} .



SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

SCAS204C – APRIL 1992 – REVISED APRIL 1998

timing requirements over recommended operating conditions (see Figures 1 through 3)

| | | 'ACT7804-20 | | 'ACT7804-25 | | 'ACT7804-40 | | UNIT |
|--------------------|-----------------|--|-----|-------------|-----|-------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | 50 | | 40 | | 25 | | MHz |
| t_w | Pulse duration | LDCK high or low | 7 | 8 | 12 | | | ns |
| | | UNCK high or low | 7 | 8 | 12 | | | |
| | | $\overline{\text{PEN}}$ low | 7 | 8 | 12 | | | |
| | | $\overline{\text{RESET}}$ low | 10 | 10 | 12 | | | |
| t_{su} | Setup time | D0–D17 before LDCK \uparrow | 5 | 5 | 5 | | | ns |
| | | $\overline{\text{PEN}}$ before LDCK \uparrow | 5 | 5 | 5 | | | |
| | | LDCK inactive before $\overline{\text{RESET}}$ high | 5 | 6 | 6 | | | |
| t_h | Hold time | D0–D17 after LDCK \uparrow | 0 | 0 | 0 | | | ns |
| | | LDCK inactive after $\overline{\text{RESET}}$ high | 5 | 6 | 6 | | | |
| | | $\overline{\text{PEN}}$ low after LDCK \uparrow | 3 | 3 | 3 | | | |
| | | $\overline{\text{PEN}}$ high after LDCK \downarrow | 0 | 0 | 0 | | | |

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50$ pF (unless otherwise noted) (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | 'ACT7804-20 | | | 'ACT7804-25 | | 'ACT7804-40 | | UNIT |
|----------------------------|-------------------------------|---------------------------|-------------|---------------|-----|-------------|-----|-------------|-----|------|
| | | | MIN | TYP \dagger | MAX | MIN | MAX | MIN | MAX | |
| f_{max} | LDCK or UNCK | | 50 | | | 40 | | 25 | | MHz |
| t_{pd} | LDCK \uparrow | Any Q | 9 | | 20 | 9 | 22 | 9 | 24 | ns |
| | UNCK \uparrow | | 6 | 11.5 | 15 | 6 | 18 | 6 | 20 | |
| t_{pd}^{\ddagger} | UNCK \uparrow | Any Q | 10.5 | | | | | | | ns |
| t_{PLH} | LDCK \uparrow | $\overline{\text{EMPTY}}$ | 6 | | 15 | 6 | 17 | 6 | 19 | ns |
| t_{PHL} | UNCK \uparrow | $\overline{\text{EMPTY}}$ | 6 | | 15 | 6 | 17 | 6 | 19 | ns |
| | $\overline{\text{RESET}}$ low | | 4 | | 16 | 4 | 18 | 4 | 20 | |
| | LDCK \uparrow | $\overline{\text{FULL}}$ | 6 | | 15 | 6 | 17 | 6 | 19 | |
| t_{PLH} | UNCK \uparrow | FULL | 6 | | 15 | 6 | 17 | 6 | 19 | ns |
| | $\overline{\text{RESET}}$ low | | 4 | | 18 | 4 | 20 | 4 | 22 | |
| t_{pd} | LDCK \uparrow | AF/AE | 7 | | 18 | 7 | 20 | 7 | 22 | ns |
| | UNCK \uparrow | | 7 | | 18 | 7 | 20 | 7 | 22 | |
| t_{PLH} | $\overline{\text{RESET}}$ low | AF/AE | 2 | | 10 | 2 | 12 | 2 | 14 | ns |
| | LDCK \uparrow | HF | 5 | | 18 | 5 | 20 | 5 | 22 | |
| t_{PHL} | UNCK \uparrow | HF | 7 | | 18 | 7 | 20 | 7 | 22 | ns |
| | $\overline{\text{RESET}}$ low | | 3 | | 12 | 3 | 14 | 3 | 16 | |
| t_{en} | $\overline{\text{OE}}$ | Any Q | 2 | | 9 | 2 | 10 | 2 | 11 | ns |
| t_{dis} | $\overline{\text{OE}}$ | Any Q | 2 | | 10 | 2 | 11 | 2 | 12 | ns |

\dagger All typical values are at $V_{\text{CC}} = 5$ V, $T_A = 25^\circ\text{C}$.

\ddagger This parameter is measured at $C_L = 30$ pF (see Figure 4).

operating characteristics, $V_{\text{CC}} = 5$ V, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|-----------------|--|-----------------|-----|------|
| C_{pd} | Power dissipation capacitance per FIFO channel | Outputs enabled | 53 | pF |

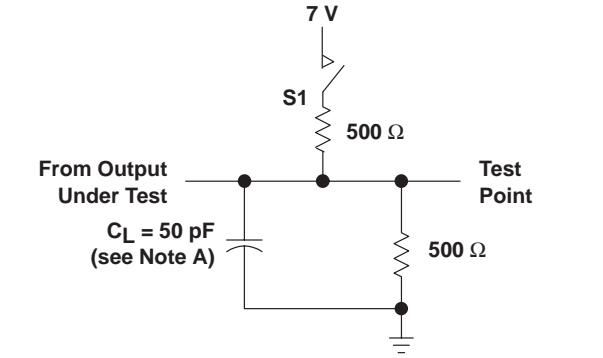


SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

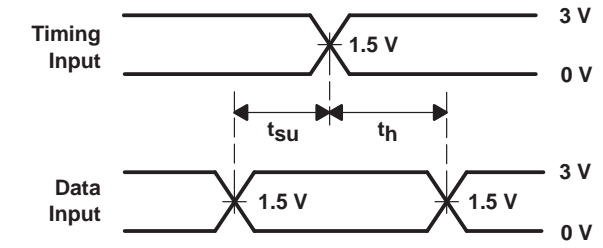
SCAS204C – APRIL 1992 – REVISED APRIL 1998

PARAMETER MEASUREMENT INFORMATION

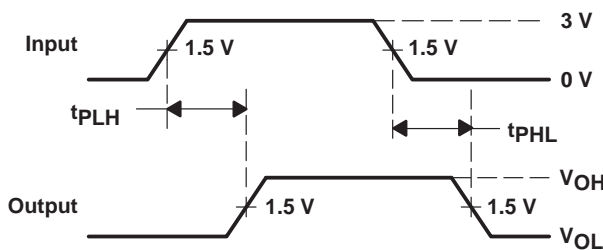


LOAD CIRCUIT

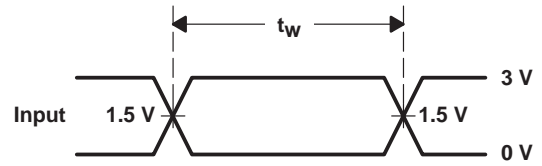
| PARAMETER | S1 | |
|-----------|-----------|--------|
| t_{en} | t_{PZH} | Open |
| | t_{PZL} | Closed |
| t_{dis} | t_{PHZ} | Open |
| | t_{PLZ} | Closed |
| t_{pd} | t_{PLH} | Open |
| | t_{PHL} | Open |



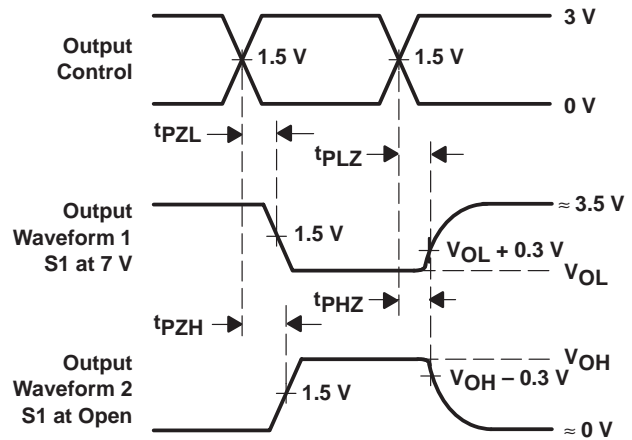
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTE A: C_L includes probe and jig capacitance.

Figure 3. Load Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

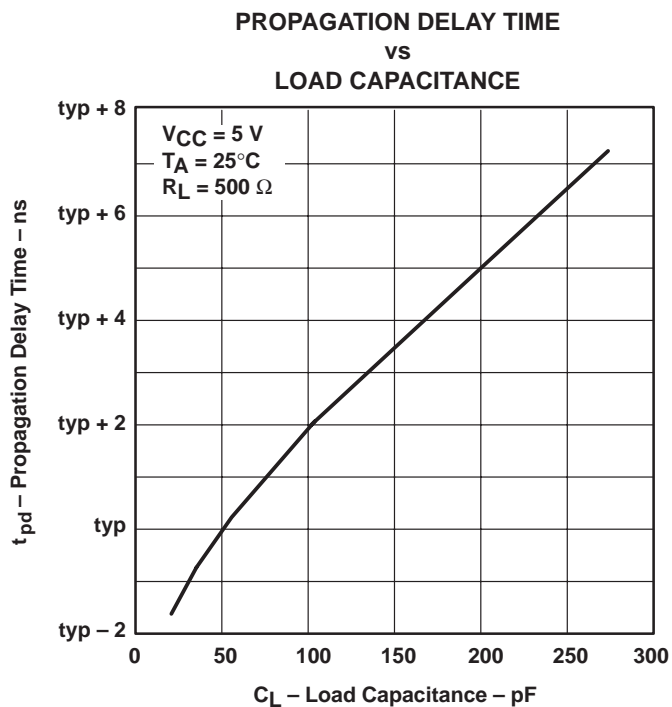


Figure 4

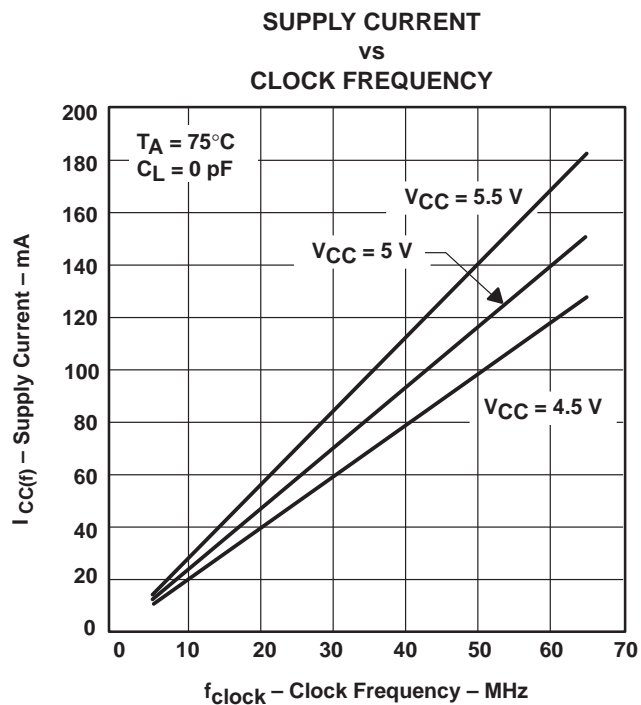


Figure 5

SN74ACT7804

512 × 18 STROBED FIRST-IN, FIRST-OUT MEMORY

SCAS204C – APRIL 1992 – REVISED APRIL 1998

APPLICATION INFORMATION

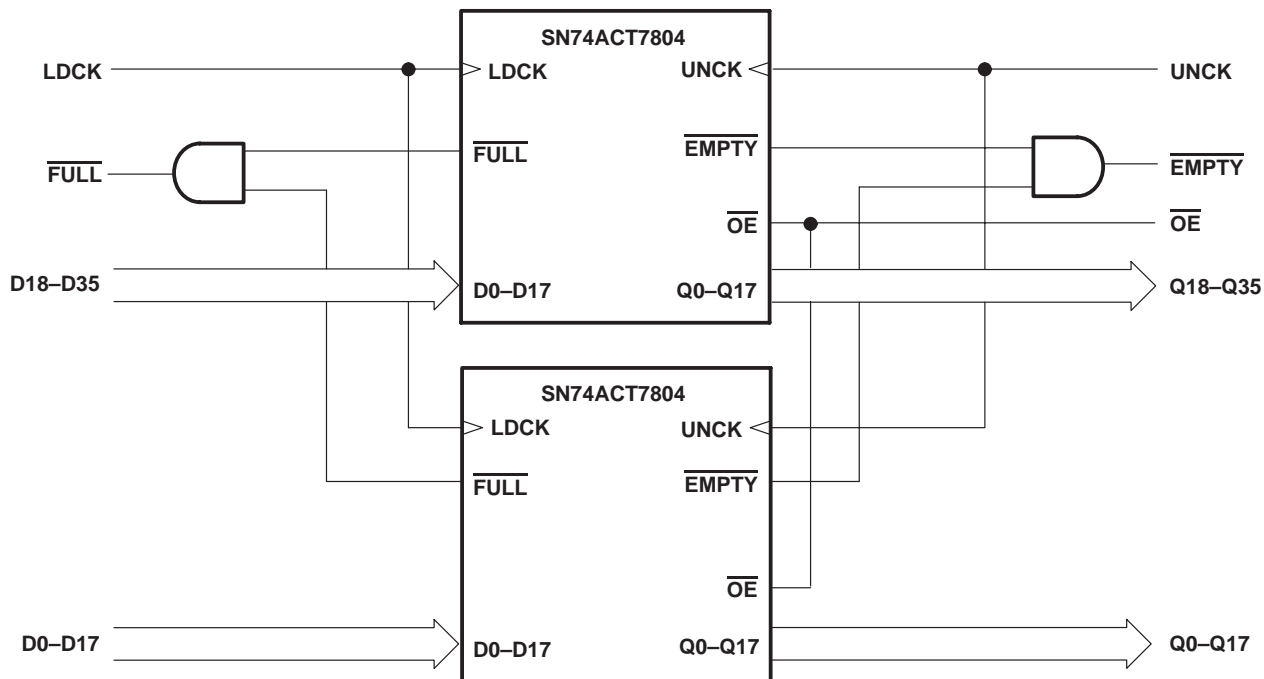


Figure 6. Word-Width Expansion: 512 × 36 Bits

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.