

- Operates at 3-V to 3.6-V V_{CC}
- Load Clock and Unload Clock Can Be Asynchronous or Coincident
- Low-Power Advanced CMOS Technology
- Full, Empty, and Half-Full Flags
- Programmable Almost-Full/Almost-Empty Flag
- Fast Access Times of 18 ns With a 50-pF Load and All Data Outputs Switching Simultaneously
- Data Rates From 0 to 40 MHz
- 3-State Outputs
- Pin Compatible With SN74ACT7804
- Packaged in Shrink Small-Outline 300-mil Package (DL) Using 25-mil Center-to-Center Spacing

description

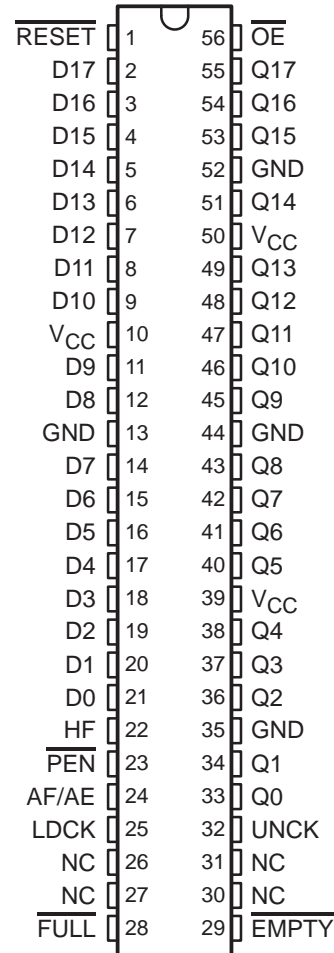
A FIFO memory is a storage device that allows data to be written into and read from its array at independent data rates. The SN74ALVC7804 is an 18-bit FIFO with high speed and fast access times. Data is processed at rates up to 40 MHz with access times of 18 ns in a bit-parallel format. The SN74ALVC7804 is designed for 3-V to 3.6-V V_{CC} operation.

Data is written into memory on a low-to-high transition of the load clock (LDCK) and is read out on a low-to-high transition of the unload clock (UNCK). 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 has no effect on the data residing in memory. When the memory is empty, UNCK has no effect.

Status of the FIFO memory is monitored by the full (\overline{FULL}), empty (\overline{EMPTY}), half-full (HF), and almost-full/almost-empty (AF/AE) flags. The \overline{FULL} output is low when the memory is full and high when the memory is not full. The \overline{EMPTY} output is low when the memory is empty and high when it is not empty. The HF output is high whenever the FIFO contains 256 or more words and is low when it contains 255 or less 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{PEN}) is low. The AF/AE flag is high when the FIFO contains X or less words or (512 minus Y) or more words. The AF/AE flag is low when the FIFO contains between (X plus 1) and (511 minus Y) words.

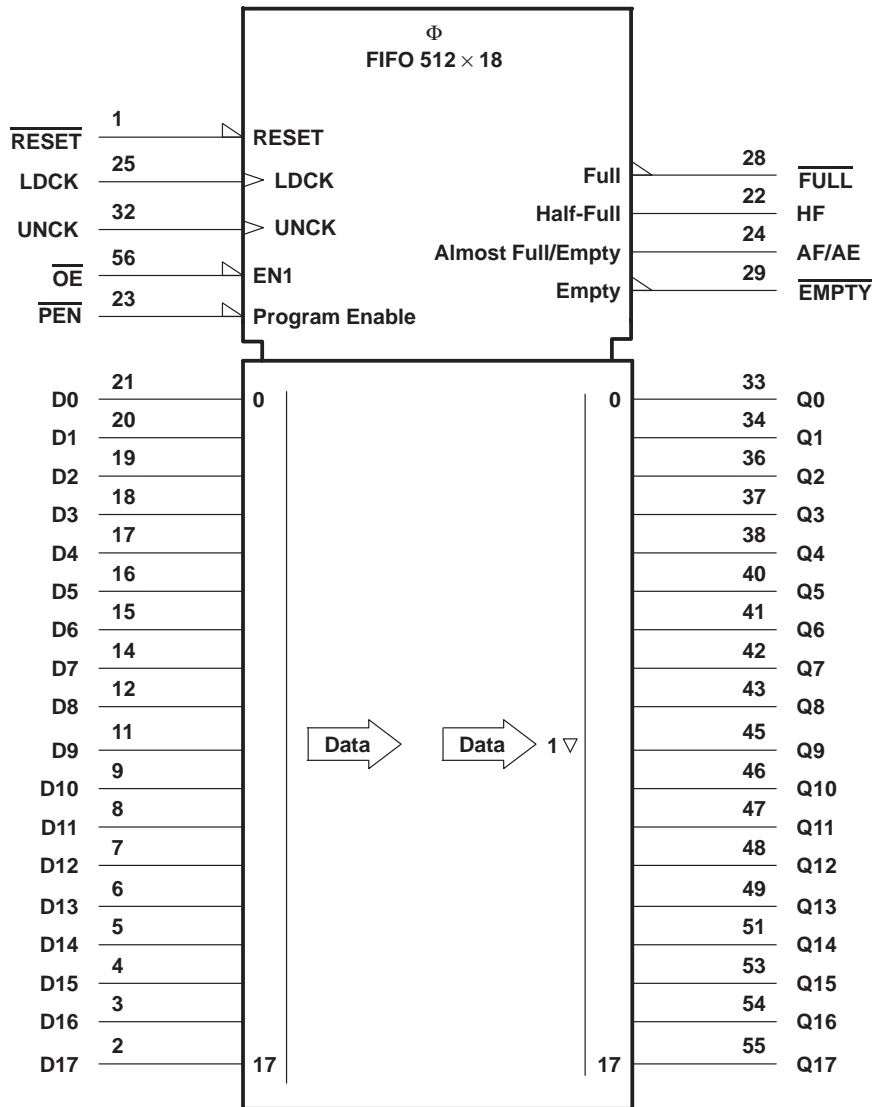
A low level on the reset (\overline{RESET}) resets the internal stack pointers and sets \overline{FULL} high, AF/AE high, HF low, and \overline{EMPTY} low. The Q outputs are not reset to any specific logic level. The FIFO must be reset upon power up. The first word loaded into empty memory causes \overline{EMPTY} to go high and the data to appear on the Q outputs. The data outputs are in the high-impedance state when the output-enable (\overline{OE}) is high.

DL PACKAGE
(TOP VIEW)



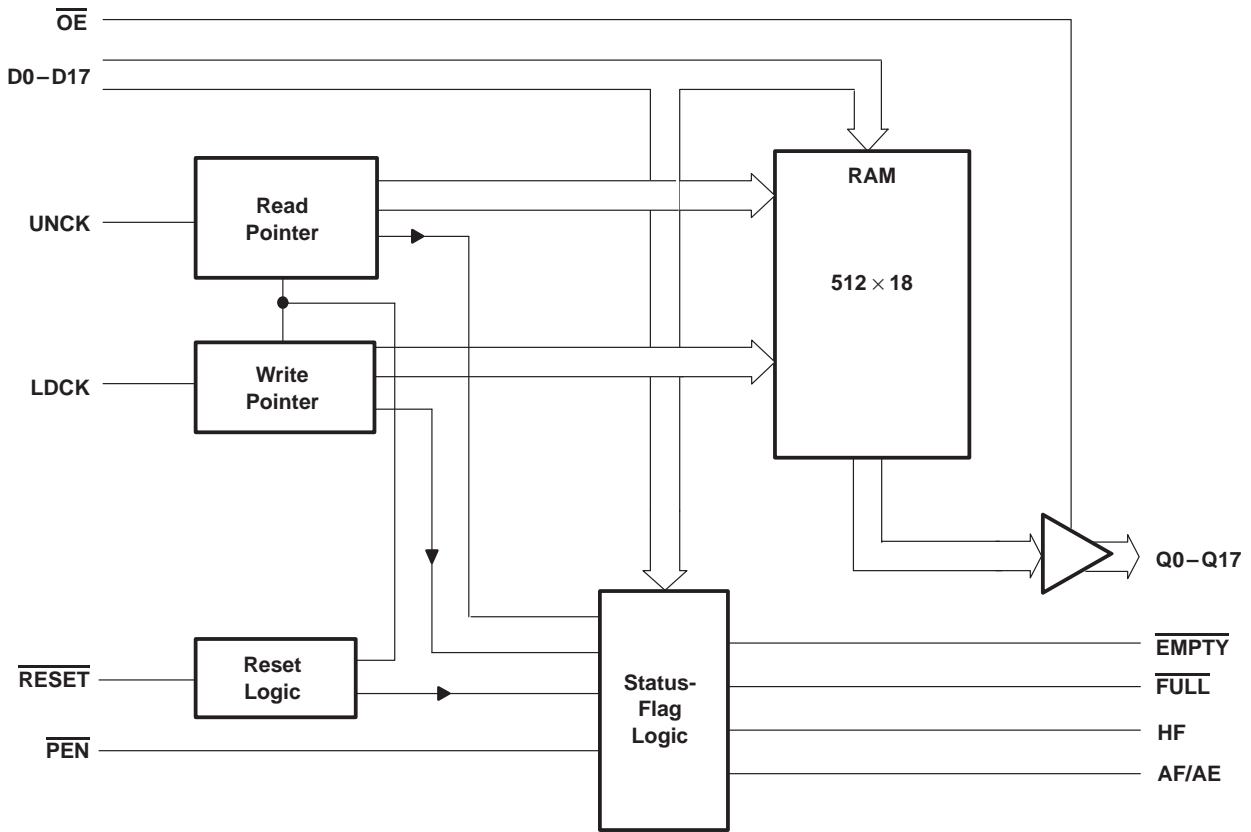
SN74ALVC7804
512 × 18
FIRST-IN, FIRST-OUT MEMORY
 SCAS432 – JANUARY 1995

logic symbol†



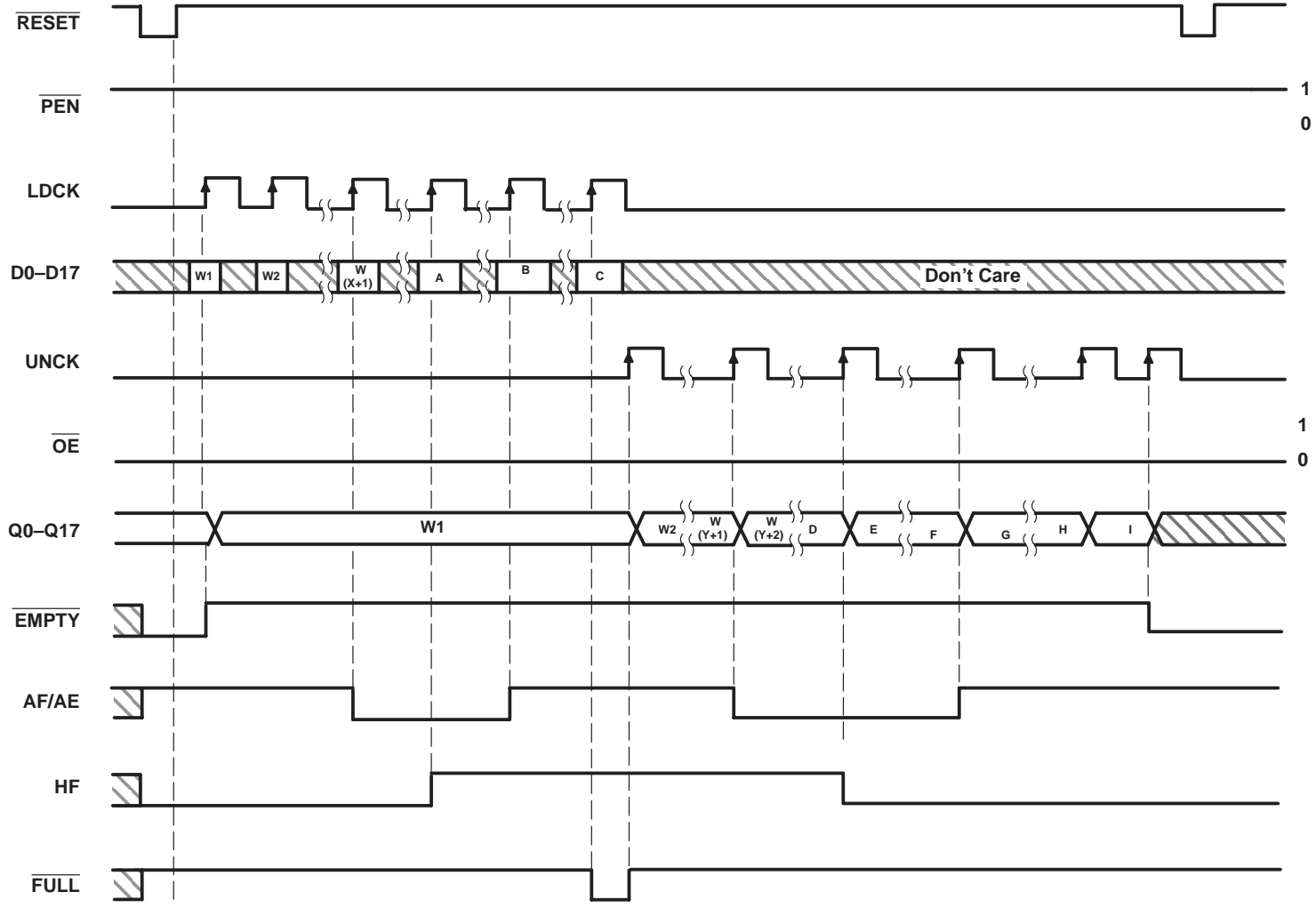
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

functional block diagram



Terminal Functions

| TERMINAL NAME | TERMINAL 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 less words or (512 - Y) or more words. AF/AE is high after reset. |
| D0-D17 | 21-14, 12-11, 9-2 | 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 WRTCLK 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. |



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

Figure 1. Write, Read, and Flag Timing Reference

DATA WORD NUMBERS FOR FLAG TRANSITIONS

| DEVICE | TRANSITION WORD | | | | | | | | |
|--------------|-----------------|----------|------|------|------|----------|----------|------|------|
| | A | B | C | D | E | F | G | H | I |
| SN74ALVC7804 | W256 | W(512-Y) | W512 | W257 | W258 | W(512-X) | W(513-X) | W511 | W512 |

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 less words or (512 minus Y) or more words.

To program the offset values, \overline{PEN} can be brought low after reset. 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{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 2). To use the default values of X = Y = 64, \overline{PEN} must be held high.

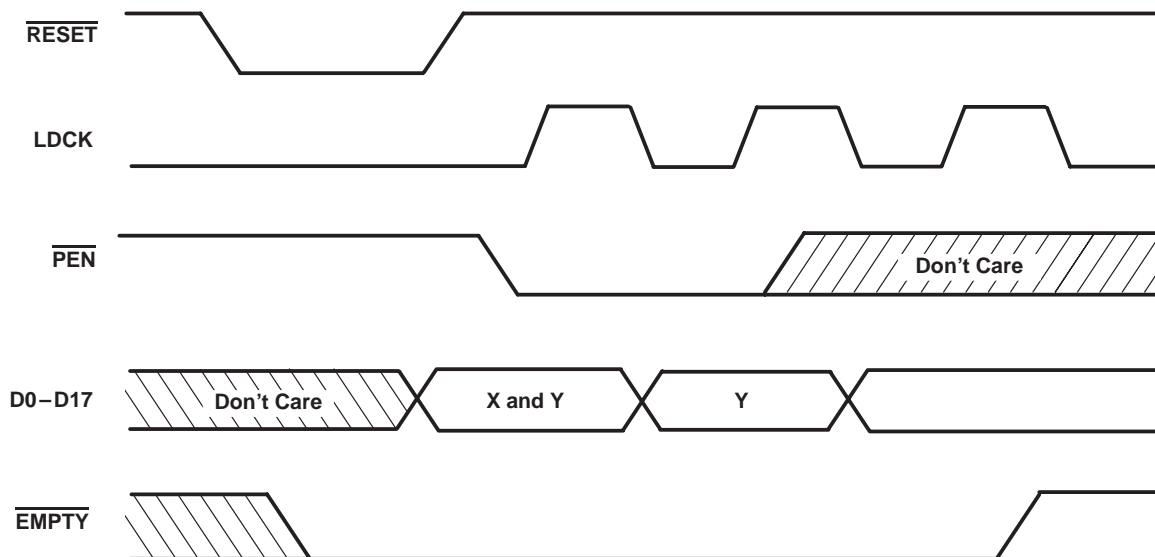


Figure 2. Programming X and Y Separately

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

| | |
|--|----------------------------|
| Supply voltage range, V_{CC} | –0.5 V to 4.6 V |
| Input voltage range, V_I (see Note 1) | –0.5 V to 4.6 V |
| Output voltage range, V_O (see Notes 1 and 2) | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, I_{IK} ($V_I < 0$) | –50 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) | ±50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ±50 mA |
| Continuous current through V_{CC} or GND | ±100 mA |
| Voltage applied to a disabled 3-state output | 3.6 V |
| Operating free-air temperature range, T_A | 0°C to 70°C |
| Storage temperature range | –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.

- NOTES: 1. The input and output voltage ratings can be exceeded if the input and output clamp current ratings are observed.
2. This value is limited to 4.6 V maximum.

recommended operating conditions

| | | 'ALVC7804-25 $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | 'ALVC7804-40 $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | UNIT |
|--------------------|--|--|----------|--|----------|------|
| | | MIN | MAX | MIN | MAX | |
| V_{IH} | High-level input voltage | 2 | | 2 | | V |
| V_{IL} | Low-level input voltage | 0.8 | | 0.8 | | V |
| V_I | | 0 | V_{CC} | 0 | V_{CC} | V |
| V_O | | 0 | V_{CC} | 0 | V_{CC} | V |
| I_{OH} | High-level output current, Q outputs, Flags | $V_{CC} = 3 \text{ V}$ | | –8 | –8 | mA |
| I_{OL} | Low-level output current, Q outputs, Flags | $V_{CC} = 3 \text{ V}$ | | 16 | 16 | mA |
| f_{clock} | Clock frequency | 40 | | 25 | | MHz |
| t_w | Pulse duration | D0–D17 high or low | | 8 | 12 | ns |
| | | LDCK high or low | | 8 | 12 | |
| | | UNCK high or low | | 8 | 12 | |
| | | $\overline{\text{PEN}}$ low | | 8 | 12 | |
| | | RESET low | | 10 | 12 | |
| t_{su} | Setup time | D0–D17 before LDCK↑ | | 5 | 5 | ns |
| | | LDCK inactive before $\overline{\text{RESET}}$ high | | 6 | 6 | |
| | | $\overline{\text{PEN}}$ before LDCK↑ | | 8 | 8 | |
| t_h | Hold time | D0–D17 after LDCK↑ | | 0 | 0 | ns |
| | | $\overline{\text{PEN}}$ high after LDCK low | | 0 | 0 | |
| | | $\overline{\text{PEN}}$ low after LDCK↑ | | 3 | 3 | |
| | | LDCK inactive after $\overline{\text{RESET}}$ high | | 6 | 6 | |
| T_A | Operating free-air temperature | 0 | 70 | 0 | 70 | °C |

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

| PARAMETER | | TEST CONDITIONS† | | MIN | TYP‡ | MAX | UNIT |
|--------------------|------------------|--|--|---------|------|------|------|
| VOH | Flags, Q outputs | VCC = MIN to MAX, | I _{OH} = – 100 μA | VCC–0.2 | | 2.4 | V |
| | | VCC = 3 V, | I _{OH} = – 8 mA | | | | |
| VOL | Flags, Q outputs | VCC = MIN to MAX, | I _{OL} = 100 μA | | | 0.2 | V |
| | Flags | VCC = 3 V, | I _{OL} = 8 mA | | | 0.4 | |
| | Q outputs | VCC = 3 V, | I _{OL} = 16 mA | | | 0.55 | |
| I _I | | VCC = 3.6 V, | V _I = VCC or GND | | | ±5 | μA |
| I _{OZ} | | VCC = 3.6 V, | V _O = VCC or GND | | | ±10 | μA |
| I _{CC} | | VCC = 3.6 V, | V _I = VCC or GND and I _O = 0 | | | 40 | μA |
| ΔI _{CC} § | | VCC = 3.6 V, Other inputs at VCC or GND | One input at VCC–0.6 V, | | | 500 | μA |
| C _i | | VCC = 3.3 V, | V _I = VCC or GND | | | 3 | pF |
| C _o | | VCC = 3.3 V, | V _O = VCC or GND | | | 6 | pF |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at VCC = 3.3 V, TA = 25°C.

§ This is the supply current for each input that is at one of the specified TTL voltage levels rather than 0 V or VCC.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, CL = 50 pF (unless otherwise noted) (see Figure 5)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | 'ALVC7804-25 VCC = 3.3 V ± 0.3 V | | 'ALVC7804-40 VCC = 3.3 V ± 0.3 V | | UNIT |
|------------------|--------------|-------------|-------------------------------------|-----|-------------------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| f _{max} | LDCK or UNCK | | 40 | | 25 | | MHz |
| t _{pd} | LDCK↑ | Any Q | 9 | 22 | 9 | 24 | ns |
| t _{pd} | UNCK↑ | | 6 | 18 | 6 | 20 | |
| t _{PLH} | LDCK↑ | EMPTY | 6 | 17 | 6 | 19 | ns |
| t _{PHL} | UNCK↑ | | 6 | 17 | 6 | 19 | |
| t _{PHL} | RESET low | | 4 | 18 | 4 | 20 | |
| t _{PHL} | LDCK↑ | FULL | 6 | 17 | 6 | 19 | ns |
| t _{PLH} | UNCK↑ | | 6 | 17 | 6 | 19 | |
| t _{PLH} | RESET low | | 4 | 20 | 4 | 22 | |
| t _{pd} | LDCK↑ | AF/AE | 7 | 20 | 7 | 22 | ns |
| t _{pd} | UNCK↑ | | 7 | 20 | 7 | 22 | |
| t _{PLH} | RESET low | | 2 | 12 | 2 | 14 | |
| t _{PLH} | LDCK↑ | HF | 5 | 20 | 5 | 22 | ns |
| t _{PHL} | UNCK↑ | | 7 | 20 | 7 | 22 | |
| t _{PHL} | RESET low | | 3 | 14 | 3 | 16 | |
| t _{en} | OE | Any Q | 2 | 10 | 2 | 11 | ns |
| t _{dis} | | | 2 | 11 | 2 | 12 | |

operating characteristics, VCC = 3.3 V, TA = 25°C

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|-----------------|--|--|-----|------|
| C _{pd} | Power dissipation capacitance per FIFO channel | Outputs enabled CL = 50 pF, f = 5 MHz | 53 | pF |

APPLICATION INFORMATION

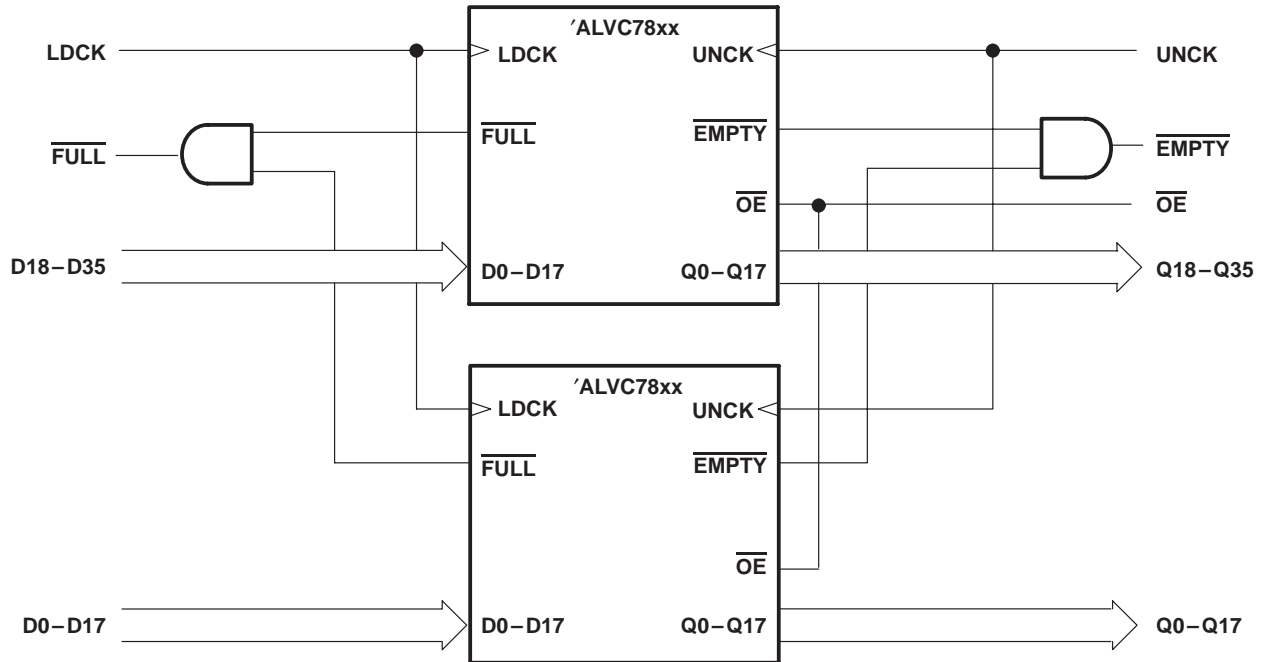


Figure 3. Word-Width Expansion: 512 × 36 Bit

TYPICAL CHARACTERISTICS

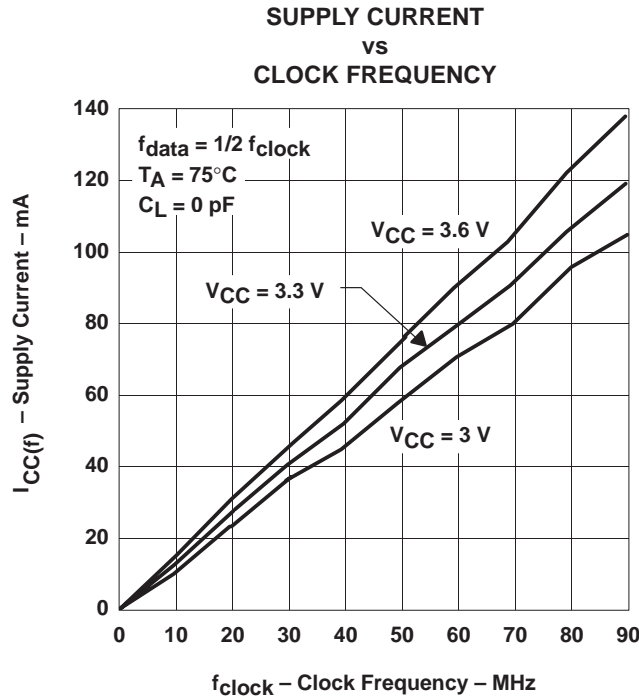


Figure 4

calculating power dissipation

With $I_{CC}(f)$ taken from Figure 4, the dynamic power (P_d), based on all data outputs changing states on each read, can be calculated by using:

$$P_d = V_{CC} \times [I_{CC}(f) + (N \times \Delta I_{CC} \times dc)] + \Sigma(C_L \times V_{CC}^2 \times f_o)$$

A more accurate total power (P_T) can be calculated if quiescent power (P_q) is also taken into consideration. Quiescent power (P_q) can be calculated using:

$$P_q = V_{CC} \times [I_{CCI} + (N \times \Delta I_{CC} \times dc)]$$

Total power will be:

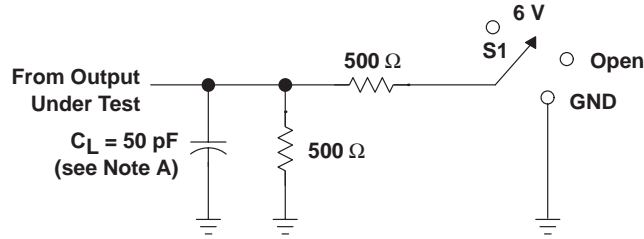
$$P_T = P_d + P_q$$

The above equations provide worst-case power calculations.

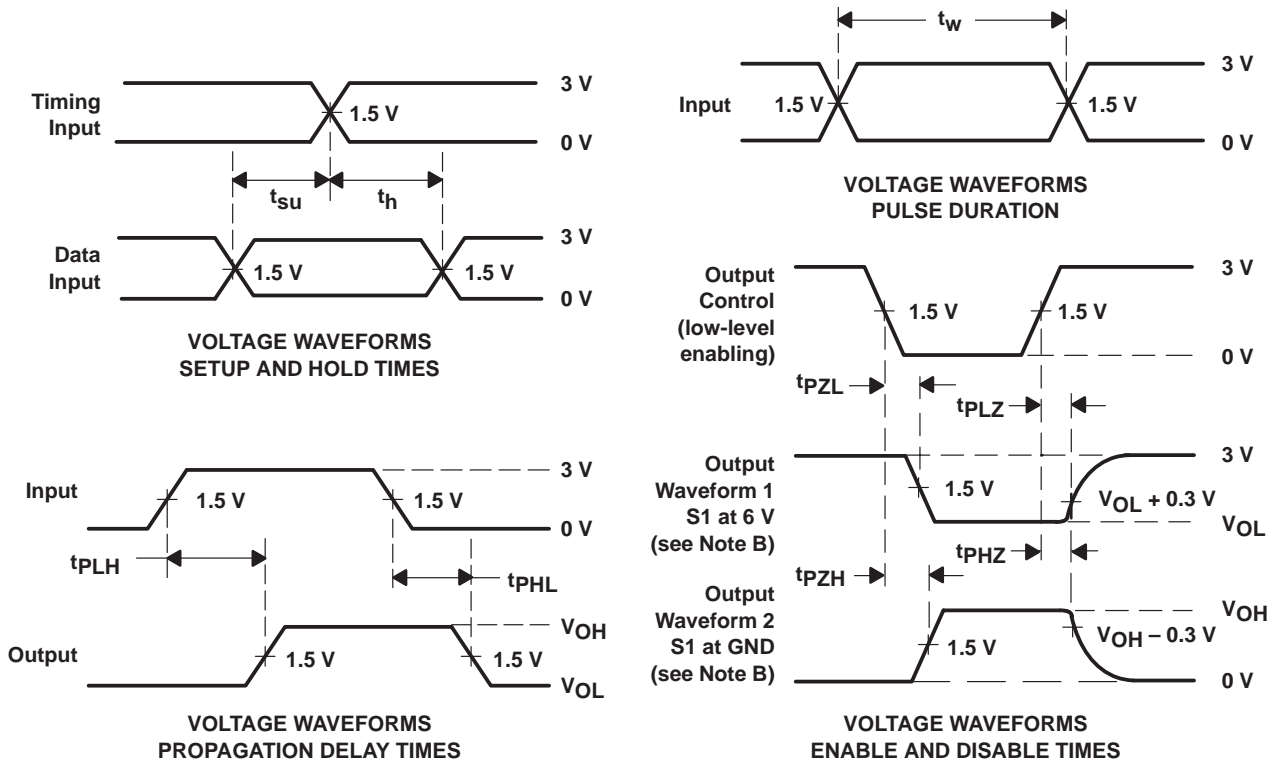
Where:

- N = number of inputs driven by TTL levels
- ΔI_{CC} = increase in power supply current for each input at a TTL high level
- dc = duty cycle of inputs at a TTL high level of 3.4 V
- C_L = output capacitance load
- f_o = switching frequency of an output
- I_{CCI} = idle current, supply current when FIFO is idle $\approx pF \times f_{clock} = 0.2 \times f_{clock}$
(current is due to free-running clocks)
- pF = power factor (the slope of idle I_{CC} versus frequency)
- $I_{CC}(f)$ = active current, supply current when FIFO is transferring data

PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT FOR OUTPUTS



- NOTES: A. C_L includes probe and jig capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 C. All input pulses are supplied by generators having the following characteristics: PRR $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.

3-STATE OUTPUTS (ANY Q)

| PARAMETER | | R1, R2 | C_L^\dagger | S1 |
|-----------|-------------------|--------------|---------------|------|
| t_{en} | t_{PZH} | 500 Ω | 50 pF | GND |
| | t_{PZL} | | | 6 V |
| t_{dis} | t_{PHZ} | 500 Ω | 50 pF | GND |
| | t_{PLZ} | | | 6 V |
| t_{pd} | t_{PLH}/t_{PHL} | 500 Ω | 50 pF | Open |

† Includes probe and test-fixture capacitance

Figure 5. Standard CMOS Outputs (FULL, EMPTY, HF, AF/AE)

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74ALVC7804-25DL | ACTIVE | SSOP | DL | 56 | 20 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74ALVC7804-40DL | ACTIVE | SSOP | DL | 56 | 20 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MO-118

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
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