

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)

RESET	1	56	OE
D17	2	55	Q17
D16	3	54	Q16
D15	4	53	Q15
D14	5	52	GND
D13	6	51	Q14
D12	7	50	V _{CC}
D11	8	49	Q13
D10	9	48	Q12
V _{CC}	10	47	Q11
D9	11	46	Q10
D8	12	45	Q9
GND	13	44	GND
D7	14	43	Q8
D6	15	42	Q7
D5	16	41	Q6
D4	17	40	Q5
D3	18	39	V _{CC}
D2	19	38	Q4
D1	20	37	Q3
D0	21	36	Q2
HF	22	35	GND
$\overline{\text{PEN}}$	23	34	Q1
AF/AE	24	33	Q0
LDCK	25	32	UNCK
NC	26	31	NC
NC	27	30	NC
FULL	28	29	EMPTY

NC – No internal connection



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**TEXAS
INSTRUMENTS**

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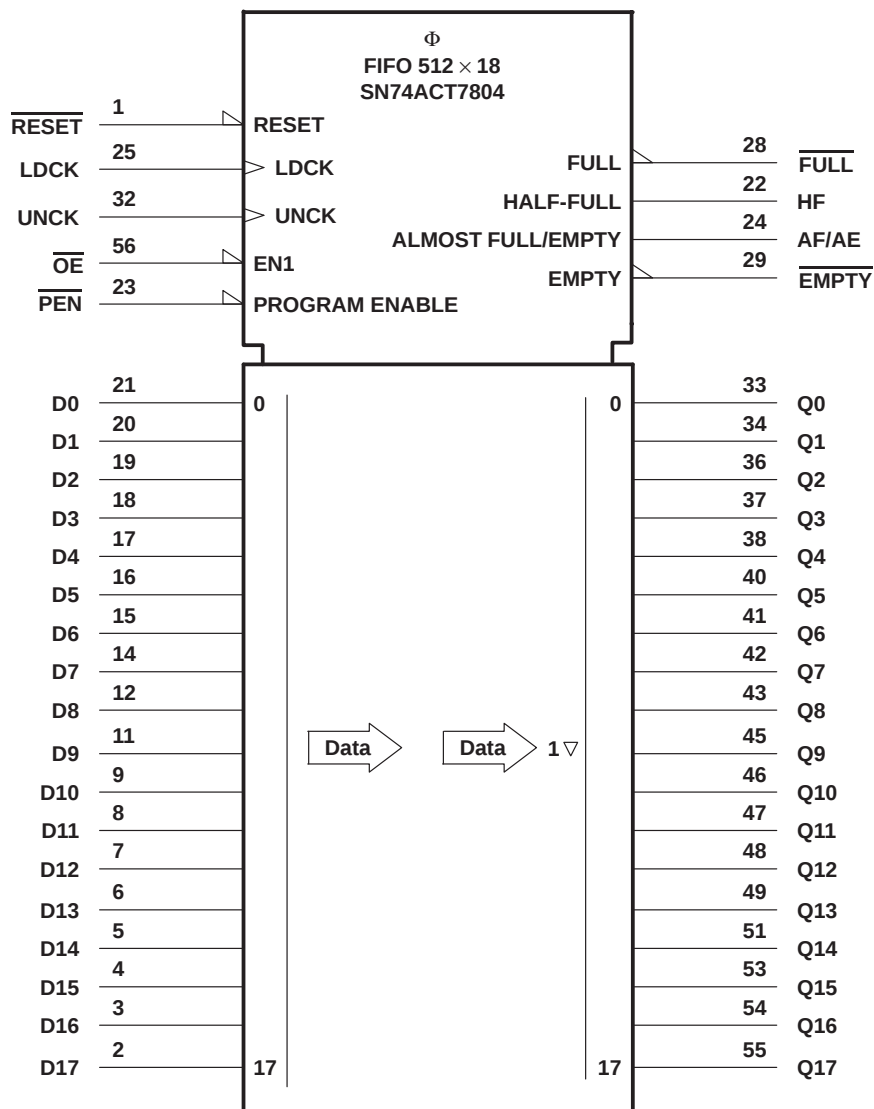
description (continued)

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.

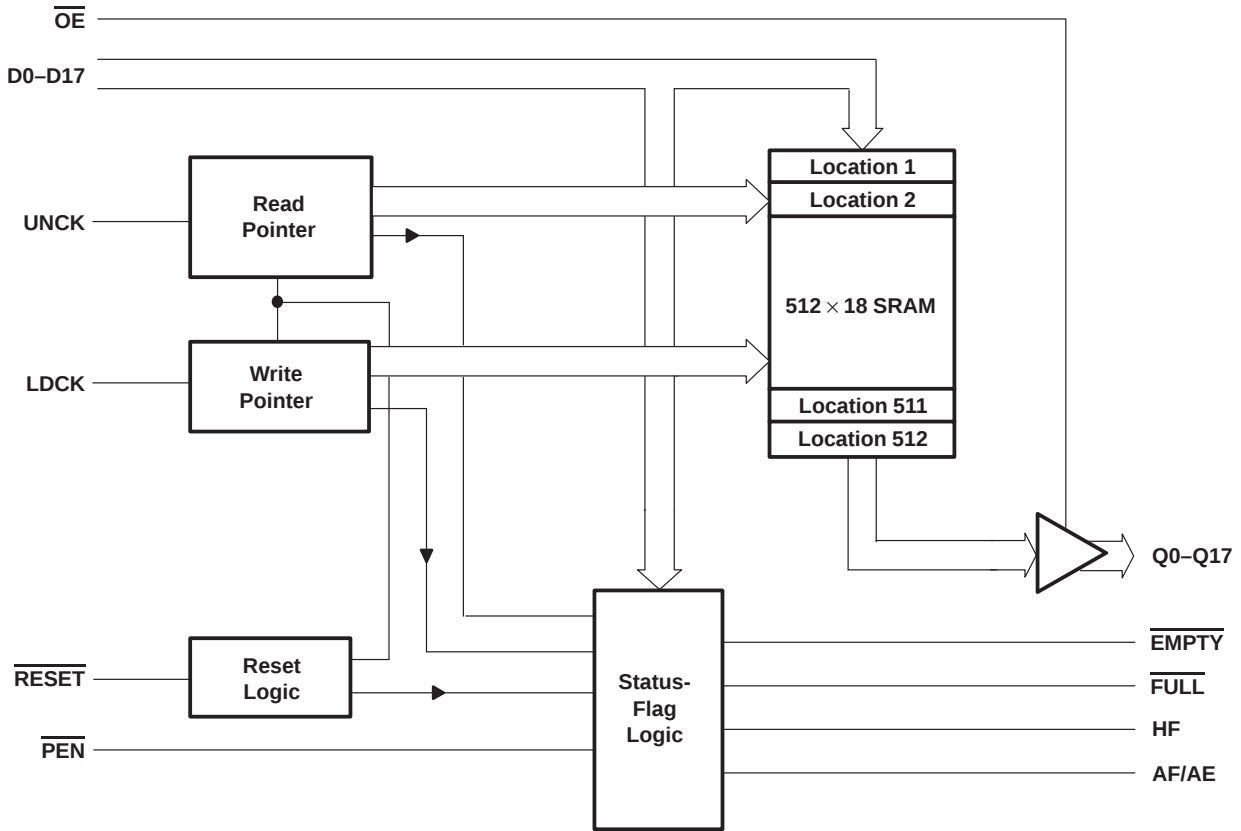
The SN74ACT7804 is characterized for operation from 0°C to 70°C.

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
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.
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.
OE	56	I	Output enable. When $\overline{\text{OE}}$ is high, the data outputs are in the high-impedance state.
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 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
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.

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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.

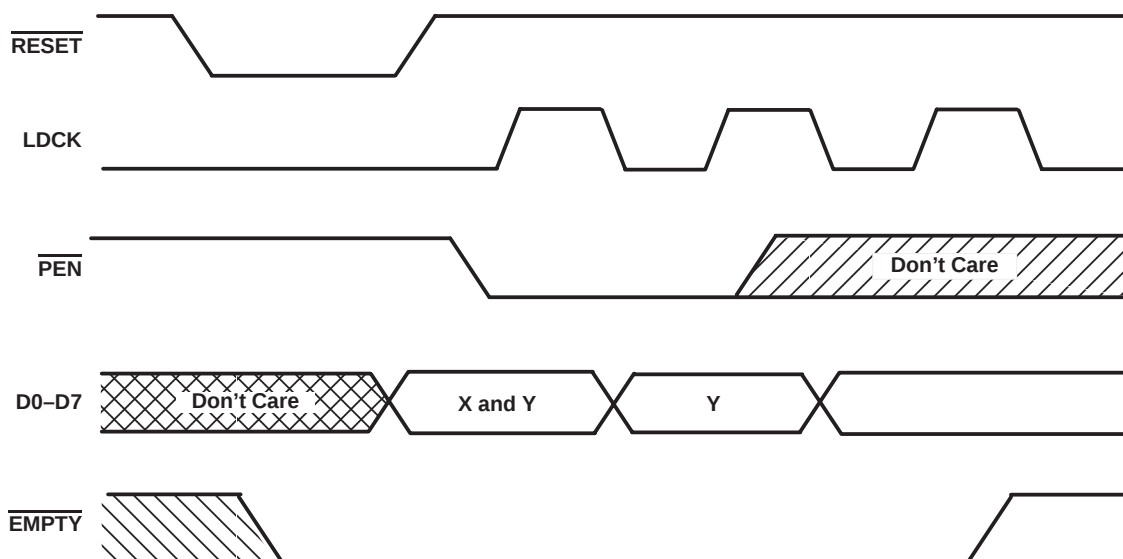
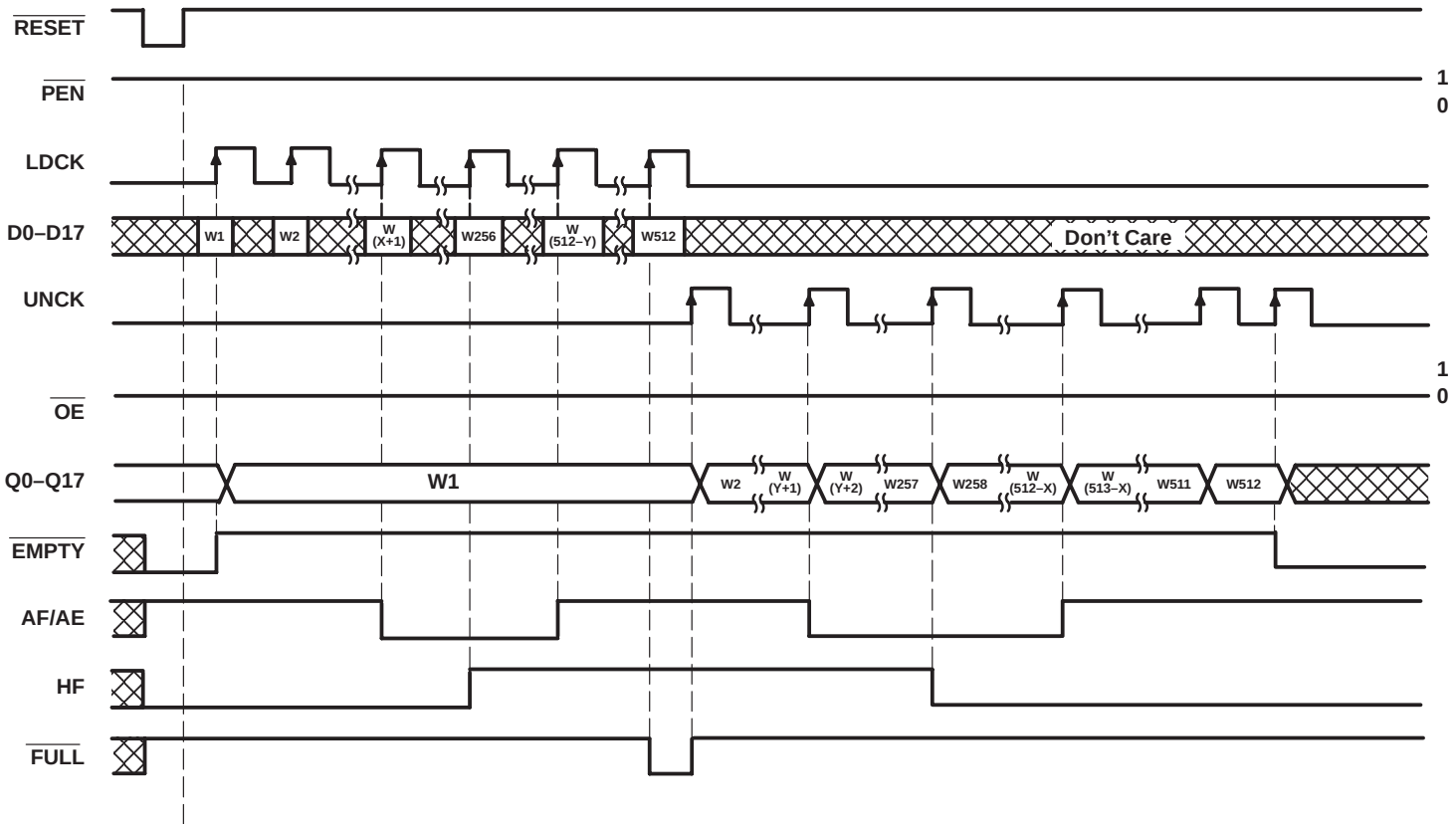


Figure 1. Programming X and Y Separately



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

Figure 2. Write, Read, and Flag Timing Reference

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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	$V_{CC} = 4.5\text{ V}$, $I_{OL} = 8\text{ mA}$			0.5	V
	Q outputs	$V_{CC} = 4.5\text{ V}$, $I_{OL} = 16\text{ mA}$			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} .

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		
		PEN low	7		8		12		
		RESET low	10		10		12		
t _{su}	Setup time	D0–D17 before LDCK↑	5		5		5		ns
		PEN before LDCK↑	5		5		5		
		LDCK inactive before RESET high	5		6		6		
t _h	Hold time	D0–D17 after LDCK↑	0		0		0		ns
		LDCK inactive after RESET high	5		6		6		
		PEN low after LDCK↑	3		3		3		
		PEN high after LDCK↓	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 [†]	MAX	MIN	MAX	MIN	MAX	
f _{max}	LDCK or UNCK		50			40		25		MHz
t _{pd}	LDCK↑	Any Q	9		20	9	22	9	24	ns
	UNCK↑		6	11.5	15	6	18	6	20	
t _{pd} [‡]	UNCK↑	Any Q	10.5							ns
t _{PLH}	LDCK↑	$\overline{\text{EMPTY}}$	6		15	6	17	6	19	ns
t _{PHL}	UNCK↑	$\overline{\text{EMPTY}}$	6		15	6	17	6	19	ns
	$\overline{\text{RESET}}$ low		4		16	4	18	4	20	
	LDCK↑	FULL	6		15	6	17	6	19	
t _{PLH}	UNCK↑	FULL	6		15	6	17	6	19	ns
	$\overline{\text{RESET}}$ low		4		18	4	20	4	22	
t _{pd}	LDCK↑	AF/AE	7		18	7	20	7	22	ns
	UNCK↑		7		18	7	20	7	22	
t _{PLH}	$\overline{\text{RESET}}$ low	AF/AE	2		10	2	12	2	14	ns
	LDCK↑	HF	5		18	5	20	5	22	
t _{PHL}	UNCK↑	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

[†] All typical values are at V_{CC} = 5 V, T_A = 25°C.

[‡] This parameter is measured at C_L = 30 pF (see Figure 4).

operating characteristics, V_{CC} = 5 V, T_A = 25°C

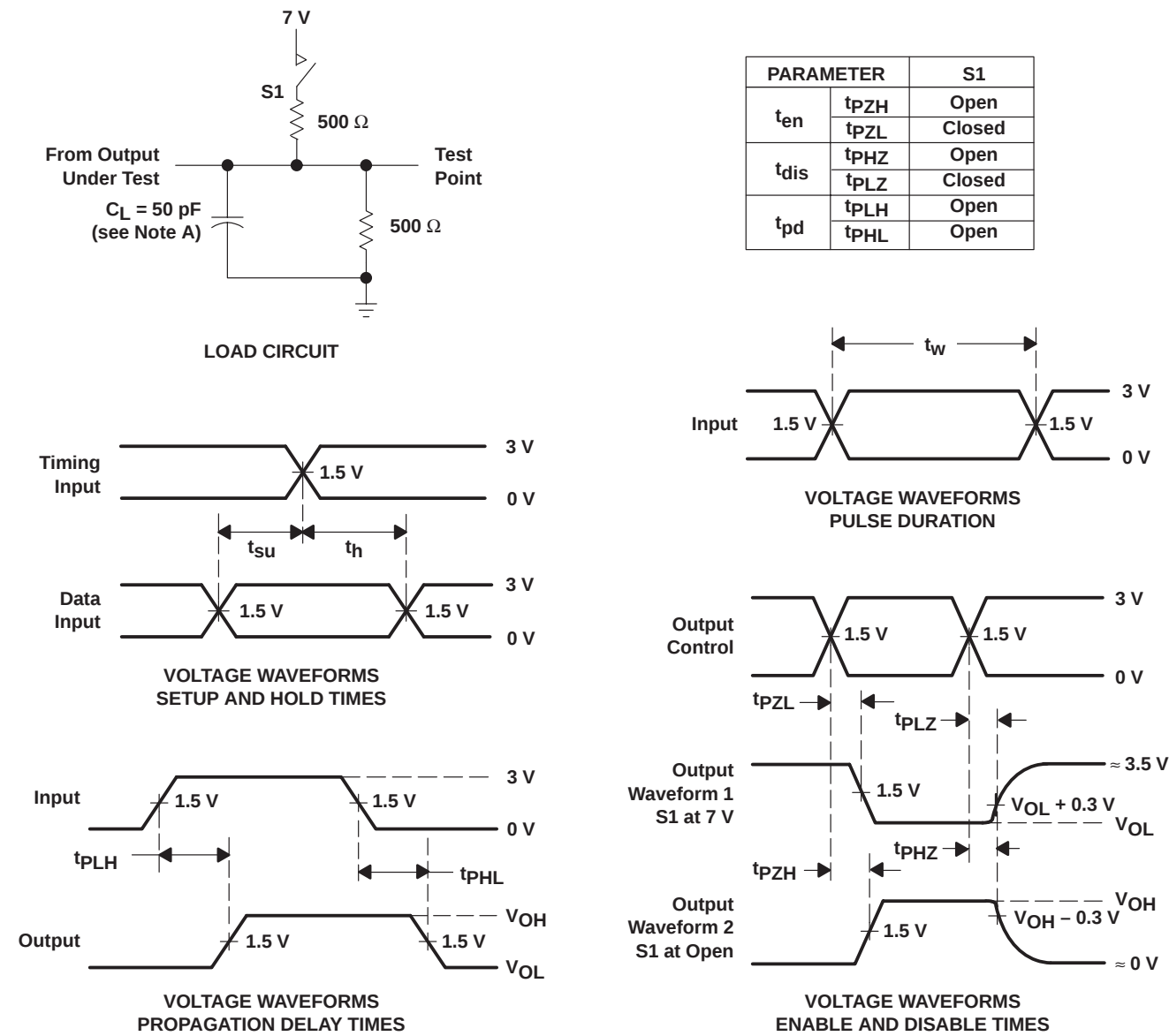
PARAMETER		TEST CONDITIONS	TYP	UNIT
C _{pd}	Power dissipation capacitance per FIFO channel	Outputs enabled C _L = 50 pF, f = 5 MHz	53	pF

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PARAMETER MEASUREMENT INFORMATION



NOTE A: C_L includes probe and jig capacitance.

Figure 3. Load Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

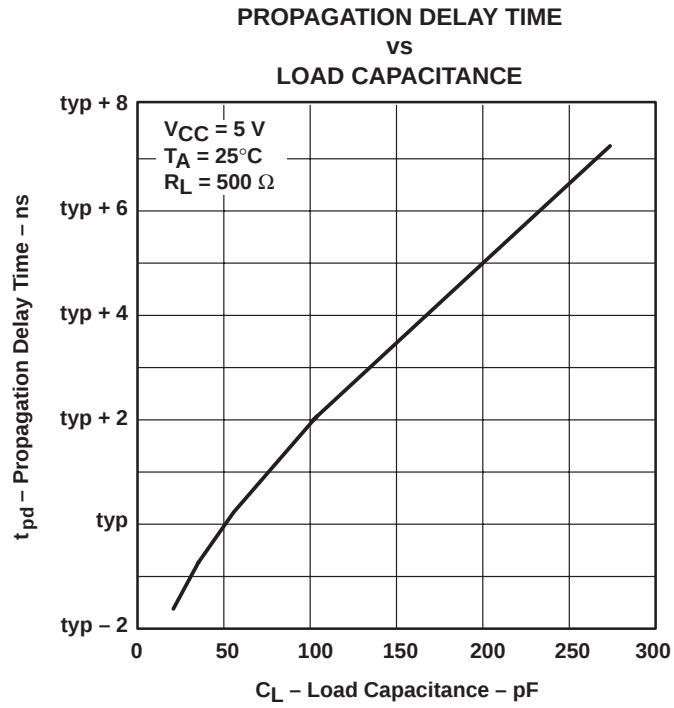


Figure 4

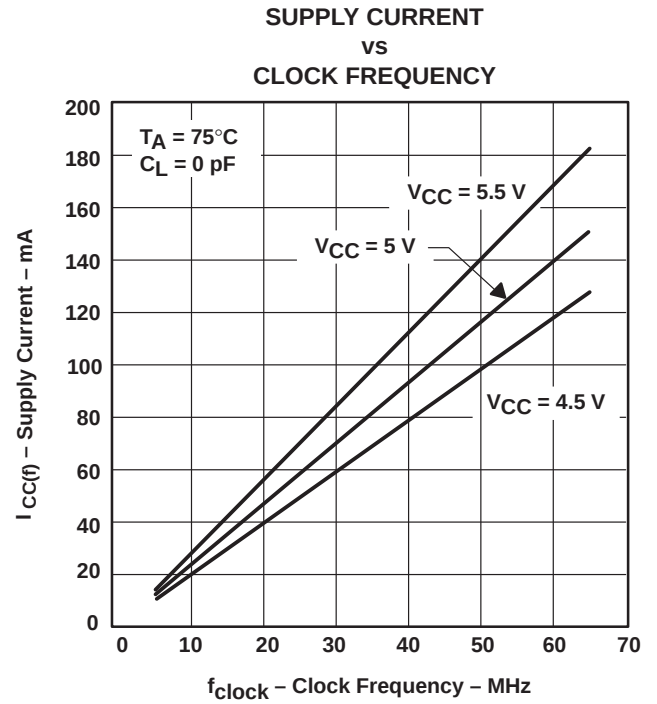


Figure 5

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APPLICATION INFORMATION

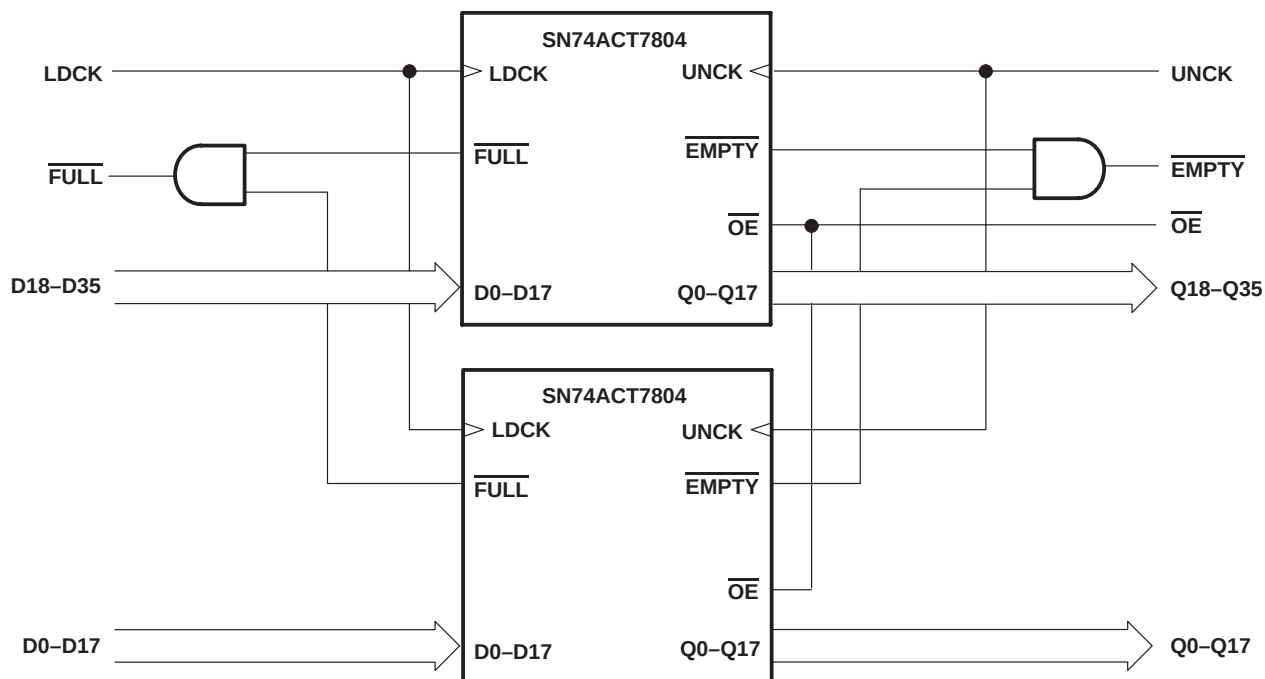


Figure 6. Word-Width Expansion: 512 × 36 Bits

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
1M7804-20DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
1M7804-20DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT7804-20DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT7804-20DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT7804-25DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT7804-25DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT7804-40DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT7804-40DLR	ACTIVE	SSOP	DL	56	1000	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.

OBSELETE: 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

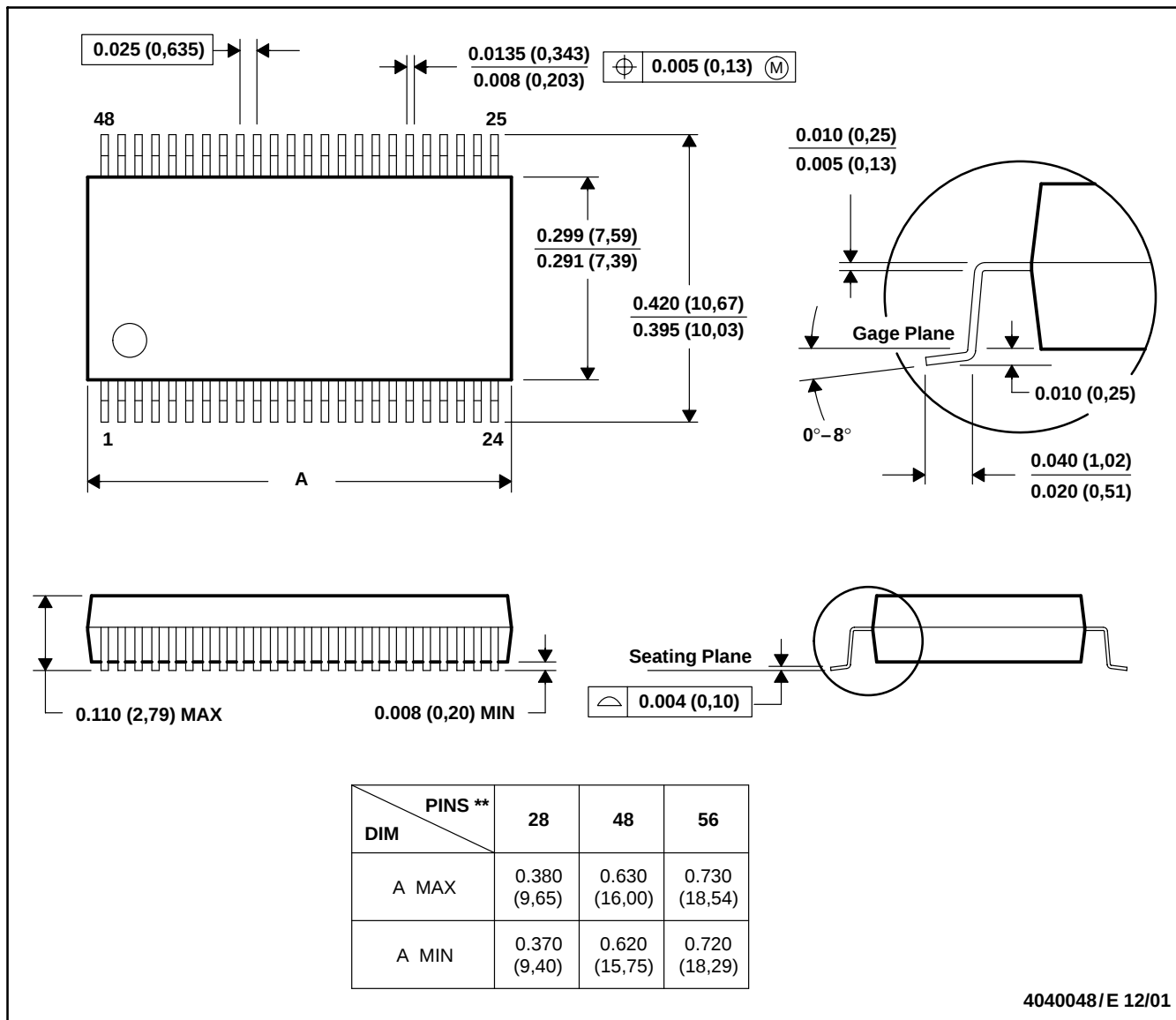
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DL (R-PDSO-G**)

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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