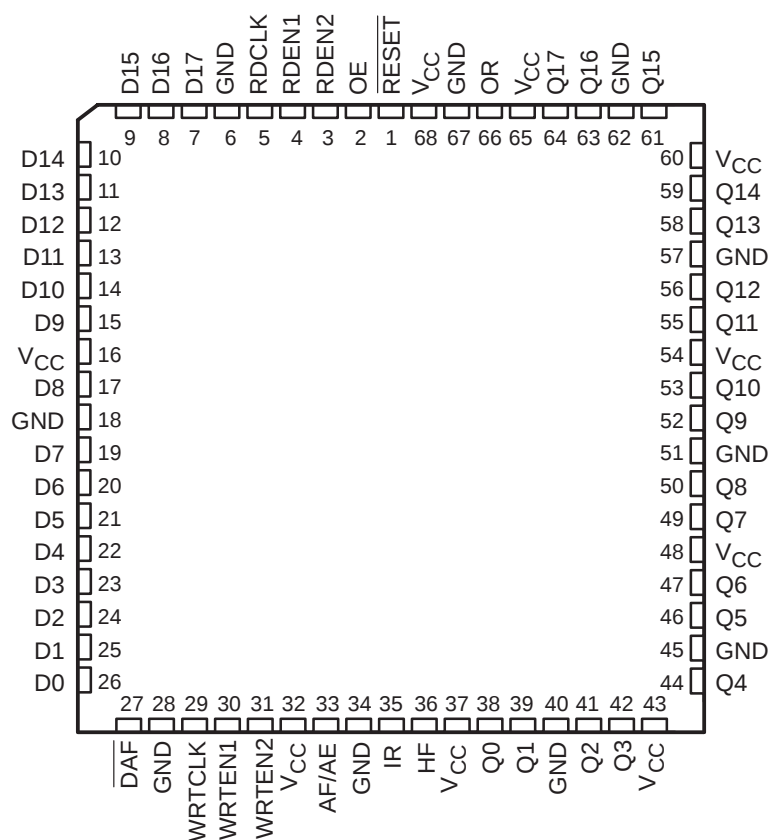


CLOCKED FIRST-IN, FIRST-OUT MEMORY

SCAS227E – FEBRUARY 1993 – REVISED APRIL 1998

- Member of the Texas Instruments Widebus™ Family
- Independent Asynchronous Inputs and Outputs
- Read and Write Operations Can Be Synchronized to Independent System Clocks
- Programmable Almost-Full/Almost-Empty Flag
- Pin-to-Pin Compatible With SN74ACT7882, SN74ACT7884, and SN74ACT7811
- Input-Ready, Output-Ready, and Half-Full Flags
- Expandable in Word Width and/or Word Depth
- Fast Access Times of 11 ns With a 50-pF Load
- High Output Drive for Direct Bus Interface
- Package Options Include 68-Pin Plastic Leaded Chip Carrier (FN) or 80-Pin Shrink Quad Flat (PN) Package

FN PACKAGE
(TOP VIEW)

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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**

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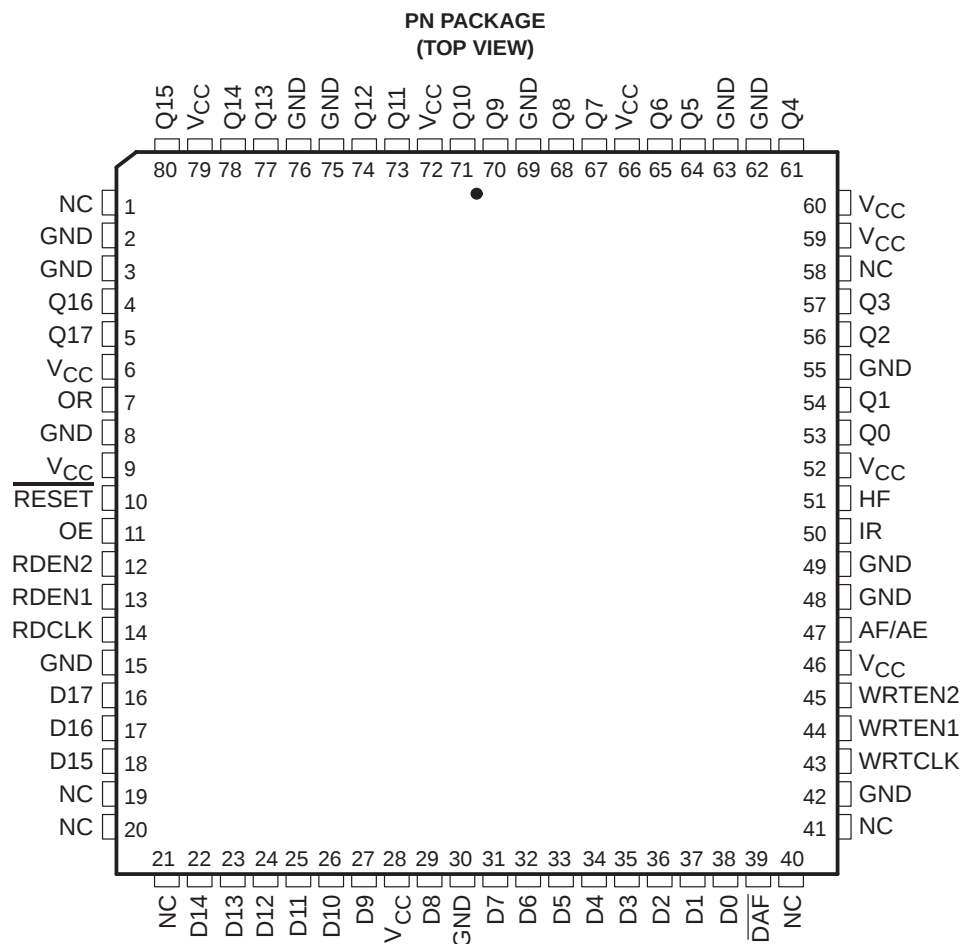
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SN74ACT7881

1024 × 18

CLOCKED FIRST-IN, FIRST-OUT MEMORY

SCAS227E – FEBRUARY 1993 – REVISED APRIL 1998



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 SN74ACT7881 is organized as 1024 × 18 bits. The SN74ACT7881 processes data at rates up to 67 MHz and access times of 11 ns in a bit-parallel format. Data outputs are noninverting with respect to the data inputs. Expansion is accomplished easily in both word width and word depth.

The SN74ACT7881 has normal input-bus to output-bus asynchronous operation. The special enable circuitry adds the ability to synchronize independent reads and writes to their respective system clocks.

The SN74ACT7881 is characterized for operation from 0°C to 70°C.

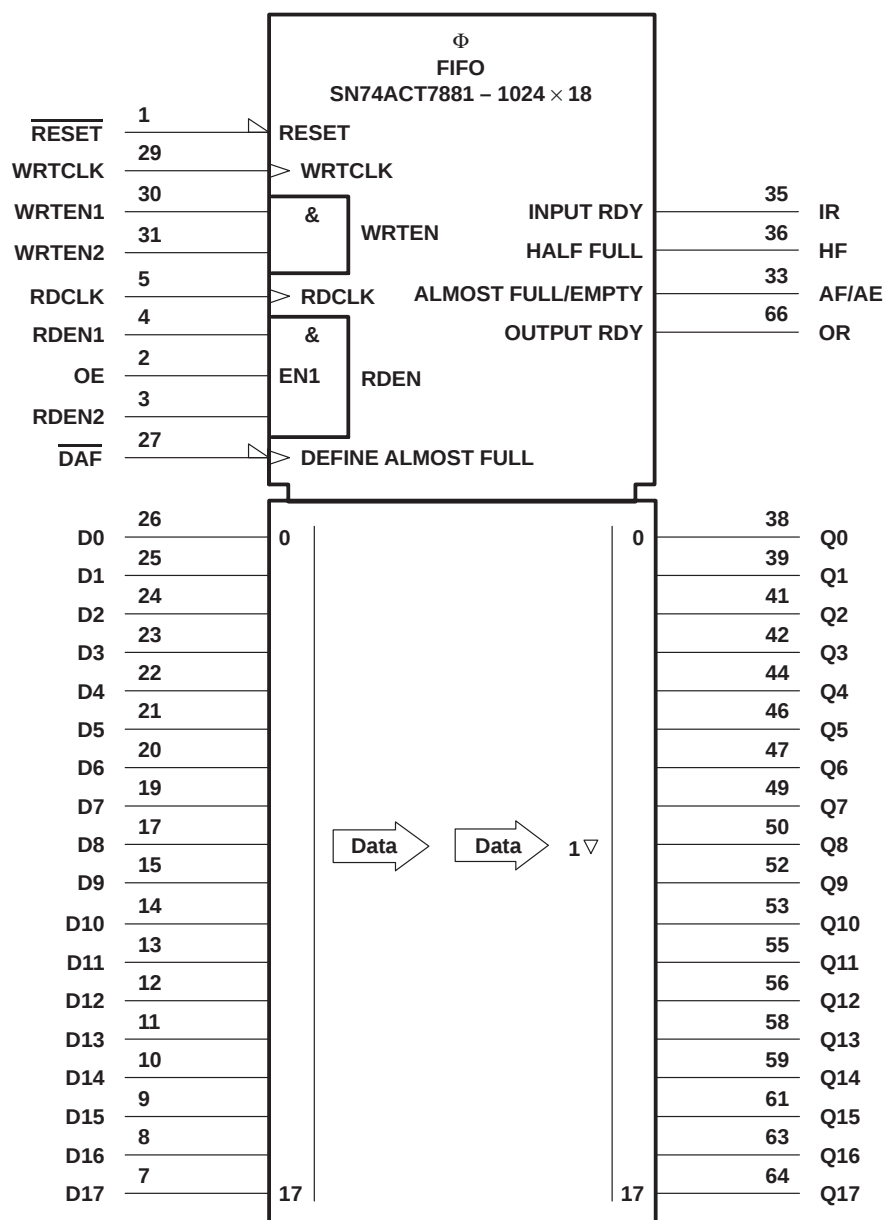


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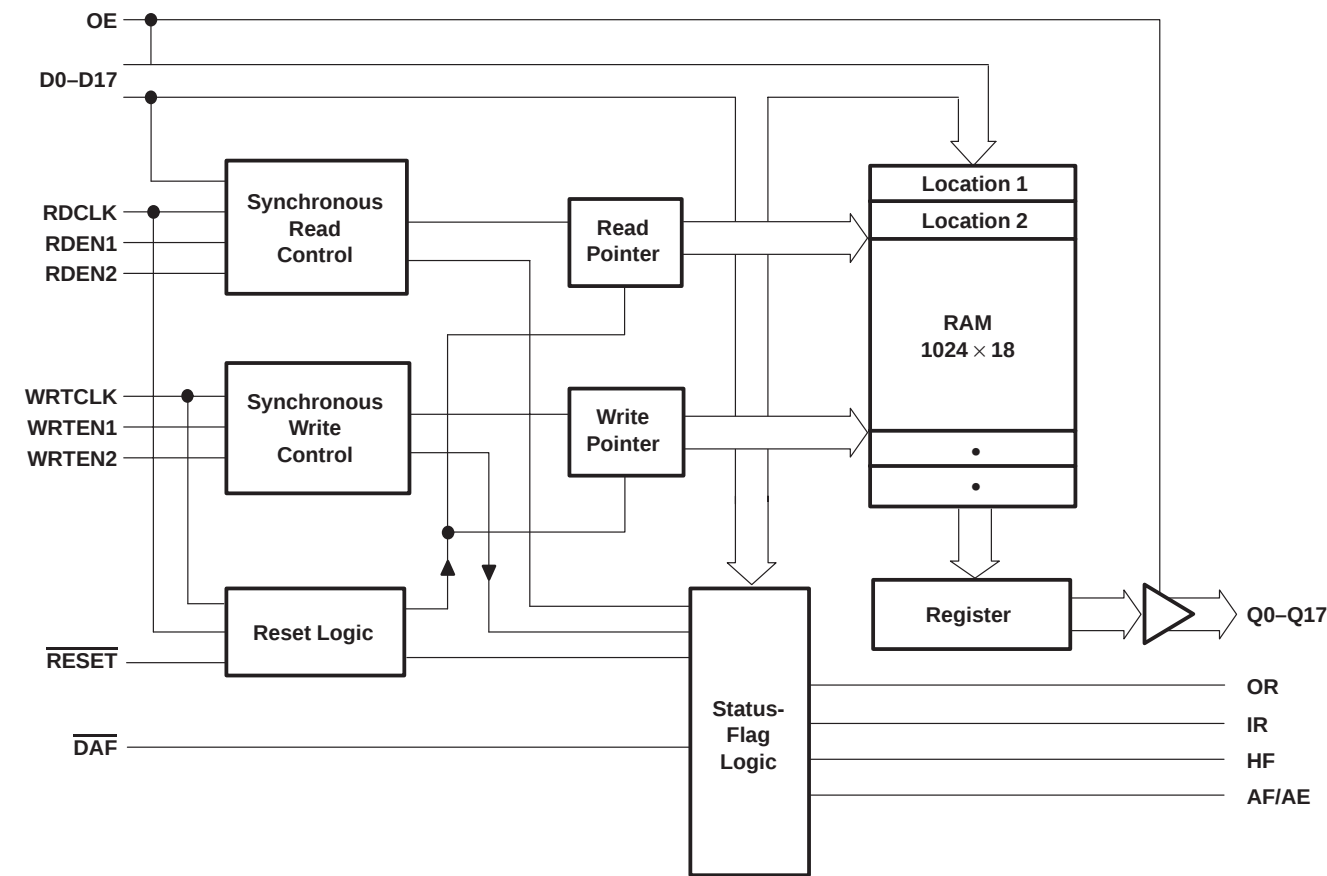
logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the FN package.

SN74ACT7881
1024 × 18
CLOCKED FIRST-IN, FIRST-OUT MEMORY
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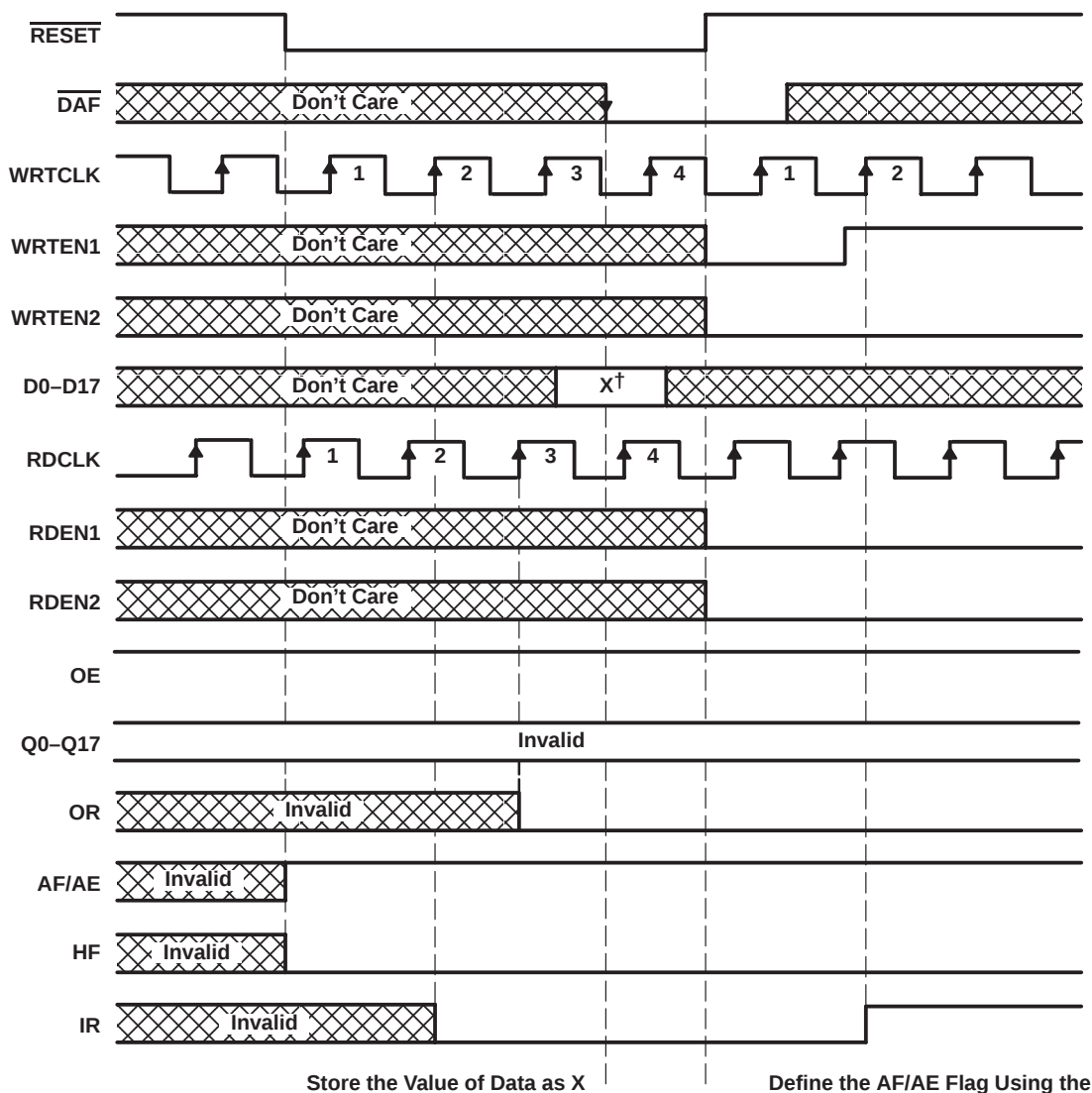
functional block diagram



Terminal Functions

TERMINAL [†] NAME NO.	I/O	DESCRIPTION
AF/AE 33	O	Almost-full/almost-empty flag. The AF/AE boundary is defined by the AF/AE offset value (X). This value can be programmed during reset, or the default value of 256 can be used. AF/AE is high when the FIFO contains (X + 1) or fewer words or (1025 – X) or more words. AF/AE is low when the FIFO contains between (X + 2) and (1024 – X) words. Programming procedure for AF/AE – The AF/AE flag is programmed during each reset cycle. The AF/AE offset value (X) is either a user-defined value or the default of X = 256. Instructions to program AF/AE using both methods are as follows: User-defined X Step 1: Take $\overline{\text{DAF}}$ from high to low. Step 2: If $\overline{\text{RESET}}$ is not already low, take $\overline{\text{RESET}}$ low. Step 3: With $\overline{\text{DAF}}$ held low, take $\overline{\text{RESET}}$ high. This defines the AF/AE using X. Step 4: To retain the current offset for the next reset, keep $\overline{\text{DAF}}$ low. Default X To redefine AF/AE using the default value of X = 256, hold $\overline{\text{DAF}}$ high during the reset cycle.
$\overline{\text{DAF}}$ 27	I	Define-almost-full. The high-to-low transition of $\overline{\text{DAF}}$ stores the binary value of data inputs as the AF/AE offset value (X). With $\overline{\text{DAF}}$ held low, a low pulse on $\overline{\text{RESET}}$ defines the AF/AE flag using X.
D0–D17 26–19, 17, 15–7	I	Data inputs for 18-bit-wide data to be stored in the memory. A high-to-low transition of $\overline{\text{DAF}}$ captures data for the AF/AE offset (X) from D8–D0.
HF 36	O	Half-full flag. HF is high when the FIFO contains 512 or more words and is low when the number of words in memory is less than half the depth of the FIFO.
IR 35	O	Input-ready flag. IR is high when the FIFO is not full and low when the device is full. During reset, IR is driven low on the rising edge of the second WRTCLK pulse. IR is then driven high on the rising edge of the second WRTCLK pulse after $\overline{\text{RESET}}$ goes high. After the FIFO is filled and IR is driven low, IR is driven high on the second WRTCLK pulse after the first valid read.
OE 2	I	Output enable. The Q0–Q17 outputs are in the high-impedance state when OE is low. OE must be high before the rising edge of RDCLK to read a word from memory.
OR 66	O	Output-ready flag. OR is high when the FIFO is not empty and low when the FIFO is empty. During reset, OR is set low on the rising edge of the third RDCLK pulse. OR is set high on the rising edge of the third RDCLK pulse to occur after the first word is written into the FIFO. OR is set low on the rising edge of the first RDCLK pulse after the last word is read.
Q0–Q17 38–39, 41–42, 44, 46–47, 49–50, 52–53, 55–56, 58–59, 61, 63–64	O	Data outputs. The first data word to be loaded into the FIFO is moved to Q0–Q17 on the rising edge of the third RDCLK pulse to occur after the first valid write. RDEN1 and RDEN2 do not affect this operation. Following data is unloaded on the rising edge of RDCLK when RDEN1, RDEN2, OE, and OR are high.
RDCLK 5	I	Read clock. Data is read out of memory on the low-to-high transition of RDCLK if OR, OE, RDEN1, and RDEN2 are high. RDCLK is a free-running clock and functions as the synchronizing clock for all data transfers out of the FIFO. OR also is driven synchronously with respect to the RDCLK signal.
RDEN1 4 RDEN2 3	I	Read enable. RDEN1 and RDEN2 must be high before a rising edge on RDCLK to read a word out of memory. RDEN1 and RDEN2 are not used to read the first word stored in memory.
$\overline{\text{RESET}}$ 1	I	Reset. A reset is accomplished by taking $\overline{\text{RESET}}$ low and generating a minimum of four RDCLK and WRTCLK cycles. This ensures that the internal read and write pointers are reset and that OR, HF, and IR are low, and AF/AE is high. The FIFO must be reset upon power up. With $\overline{\text{DAF}}$ at a low level, a low pulse on $\overline{\text{RESET}}$ defines AF/AE using the AF/AE offset value (X), where X is the value previously stored. With $\overline{\text{DAF}}$ at a high level, a low-level pulse on $\overline{\text{RESET}}$ defines the AF/AE flag using the default value of X = 256.
WRTCLK 29	I	Write clock. Data is written into memory on a low-to-high transition of WRTCLK if IR, WRTEN1, and WRTEN2 are high. WRTCLK is a free-running clock and functions as the synchronizing clock for all data transfers into the FIFO. IR also is driven synchronously with respect to WRTCLK.
WRTEN1 30 WRTEN2 31	I	Write enable. WRTEN1 and WRTEN2 must be high before a rising edge on WRTCLK for a word to be written into memory. WRTEN1 and WRTEN2 do not affect the storage of the AF/AE offset value (X).

[†] Terminals listed are for the FN package.



[†] X is the binary value on D8-D0.

Figure 1. Reset Cycle: Define AF/AE Flag Using a Programmed Value of X

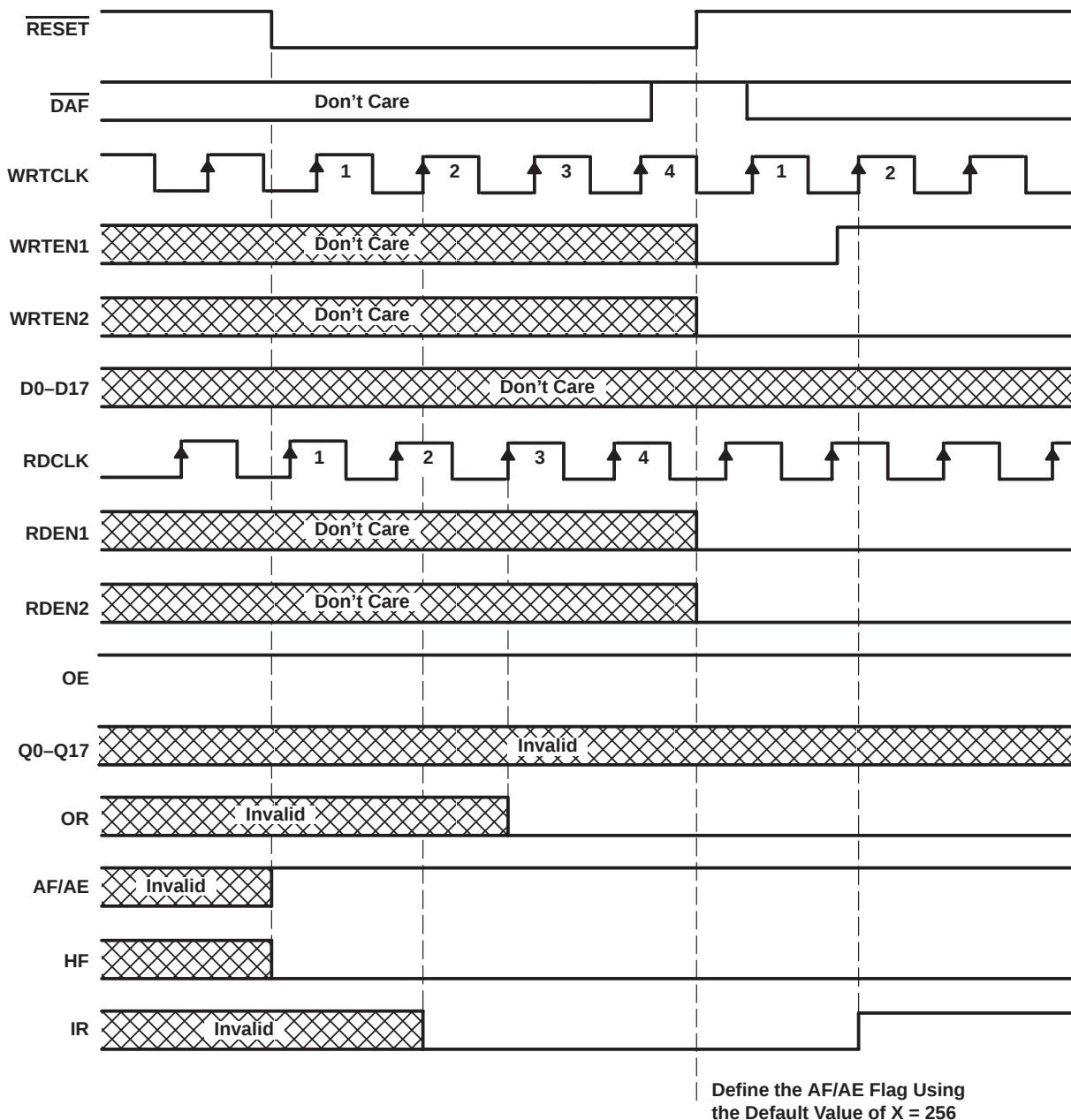
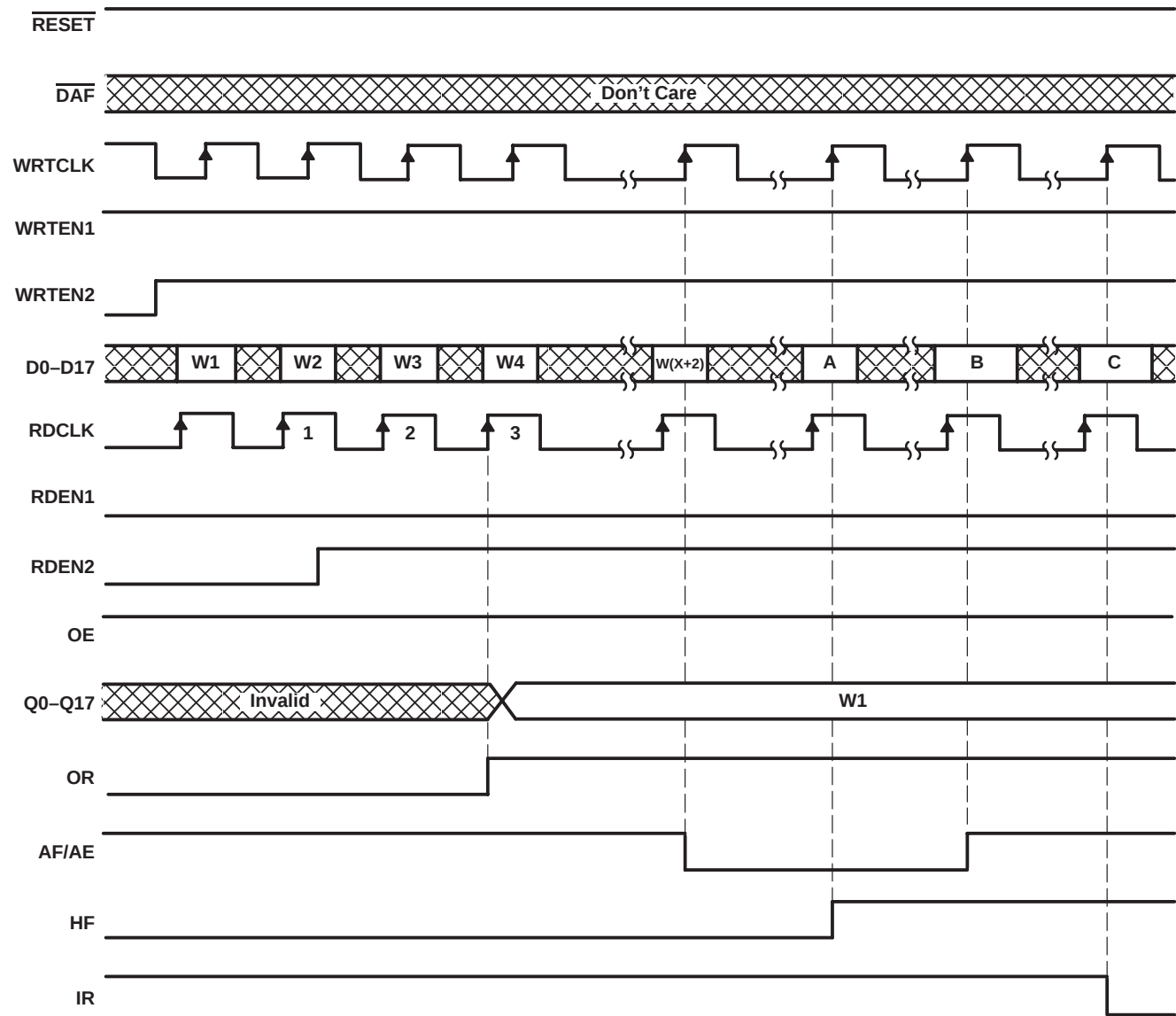


Figure 2. Reset Cycle: Define AF/AE Flag Using the Default Value of X = 256



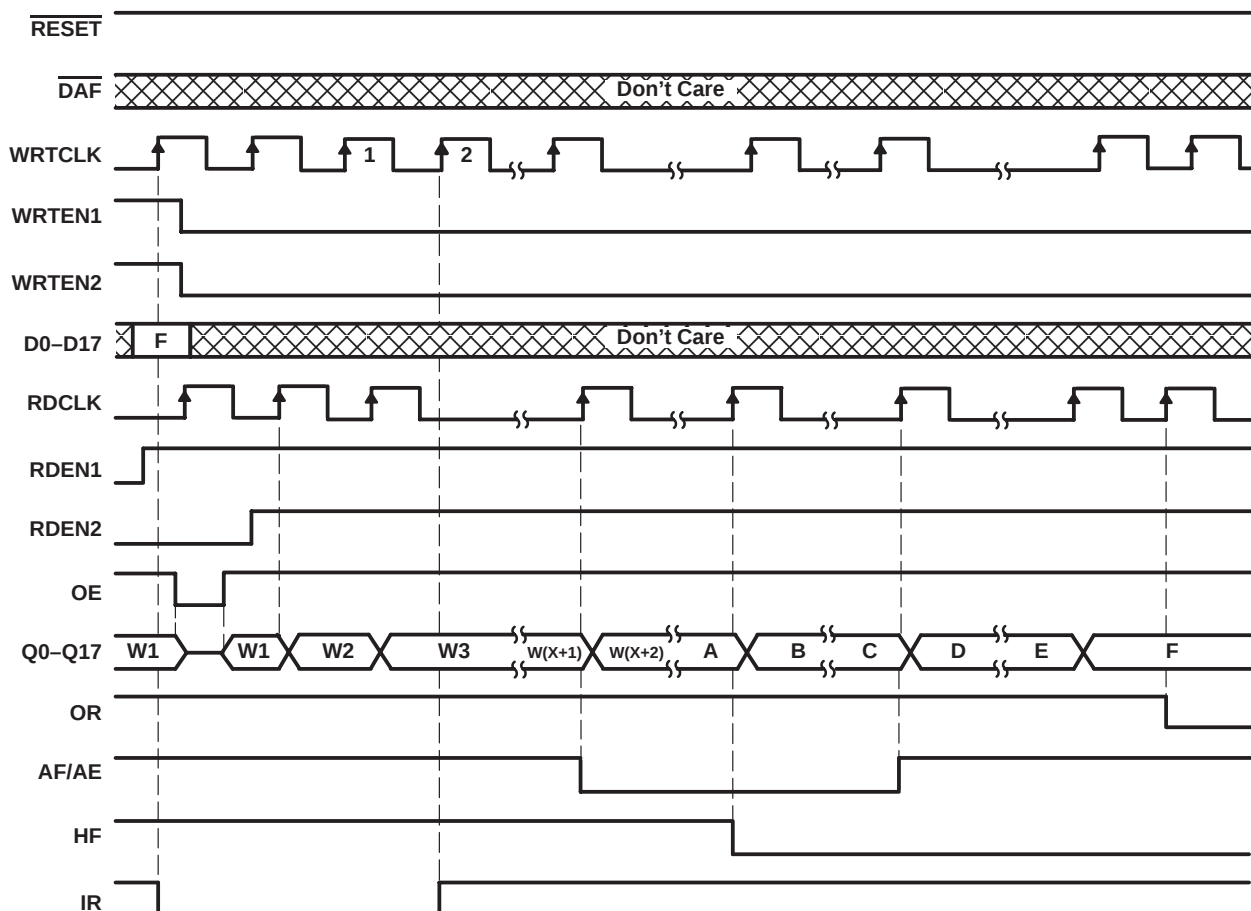
DATA-WORD NUMBERS FOR FLAG TRANSITIONS

TRANSITION WORD		
A	B	C
W513	W(1025 – X)	W1025

Figure 3. Write Cycle

CLOCKED FIRST-IN, FIRST-OUT MEMORY

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DATA-WORD NUMBERS FOR FLAG TRANSITIONS

TRANSITION WORD					
A	B	C	D	E	F
W513	W514	W(1024 – X)	W(1025 – X)	W1024	W1025

Figure 4. Read Cycle

absolute maximum ratings over operating free-air temperature range†

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): FN package	39°C/W
PN package	62°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

	MIN	MAX	UNIT
V_{CC} Supply voltage	4.5	5.5	V
V_{IH} High-level input voltage	2		V
V_{IL} Low-level input voltage		0.8	V
I_{OH} High-level output current		–8	mA
I_{OL} Low-level output current		16	mA
T_A Operating free-air temperature	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}	$V_{CC} = 4.5\text{ V}$, $I_{OL} = 16\text{ mA}$			0.5	V
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
$I_{CC}^{\S}$	$V_I = V_{CC} - 0.2\text{ V}$ or 0			400	µA
	One input at 3.4 V, Other inputs at V_{CC} or GND			1.2	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 $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.

§ I_{CC} is tested with outputs open.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (see Figures 1 through 5)

		'ACT7881-15		'ACT7881-20		'ACT7881-30		UNIT		
		MIN	MAX	MIN	MAX	MIN	MAX			
f _{clock}	Clock frequency	67		50		33.4		MHz		
t _w	Pulse duration	WRTCLK high		5		7		8.5		ns
		WRTCLK low		7		7		11		
		RDCLK high		5		7		8.5		
		RDCLK low		7		7		11		
		DAF high		7		7		10		
t _{su}	Setup time	D0–D17 before WRTCLK↑		5		5		5		ns
		WRTEN1, WRTEN2 high before WRTCLK↑		4		5		5		
		OE, RDEN1, RDEN2 high before RDCLK↑		4		5		5		
		Reset: $\overline{\text{RESET}}$ low before first WRTCLK↑ and RDCLK↑†		5		6		7		
		Define AF/AE: D0–D8 before $\overline{\text{DAF}}$ ↓		3		5		5		
		Define AF/AE: $\overline{\text{DAF}}$ ↓ before $\overline{\text{RESET}}$ ↑		3		6		7		
		Define AF/AE (default): DAF high before $\overline{\text{RESET}}$ ↑		4		5		5		
t _h	Hold time	D0–D17 after WRTCLK↑		0		0		0		ns
		WRTEN1, WRTEN2 high after WRTCLK↑		0		0		0		
		OE, RDEN1, RDEN2 high after RDCLK↑		0		0		0		
		Reset: $\overline{\text{RESET}}$ low after fourth WRTCLK↑ and RDCLK↑†		0		0		0		
		Define AF/AE: D0–D8 after $\overline{\text{DAF}}$ ↓		0		0		0		
		Define AF/AE: $\overline{\text{DAF}}$ low after $\overline{\text{RESET}}$ ↑		0		0		0		
		Define AF/AE (default): DAF high after $\overline{\text{RESET}}$ ↑		0		0		0		

[†] To permit the clock pulse to be utilized for reset purposes

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	'ACT7881-15		'ACT7881-20		'ACT7881-30		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f _{max}	WRTCLK or RDCLK		67		50		33.4		MHz
t _{pd}	RDCLK↑	Any Q	3	12	3	13	3	18	ns
t _{pd} [‡]	RDCLK↑	Any Q							ns
t _{pd}	WRTCLK↑	IR	2	8	2	9.5	2	12	ns
	RDCLK↑	OR	2	8	2	9.5	2	12	
	WRTCLK↑	AF/AE	6	17	6	19	6	22	
	RDCLK↑		6	17	6	19	6	22	
t _{PLH}	WRTCLK↑	HF	6	14	6	17	6	21	ns
t _{PHL}	RDCLK↑	HF	6	14	6	17	6	21	ns
t _{PLH}	RESET↓	AF/AE	3	12	3	17	3	21	ns
t _{PHL}	RESET↓	HF	3	14	3	19	3	23	ns
t _{en}	OE	Any Q	2	9	2	11	2	11	ns
t _{dis}	OE	Any Q	2	10	2	14	2	14	ns

[‡] This parameter is measured with $C_L = 30$ pF (see Figure 6).

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

PARAMETER	TEST CONDITIONS	TYP	UNIT
C_{pd} Power dissipation capacitance per 1K bits	$C_L = 50\text{ pF}$, $f = 5\text{ MHz}$	65	pF

PARAMETER MEASUREMENT INFORMATION

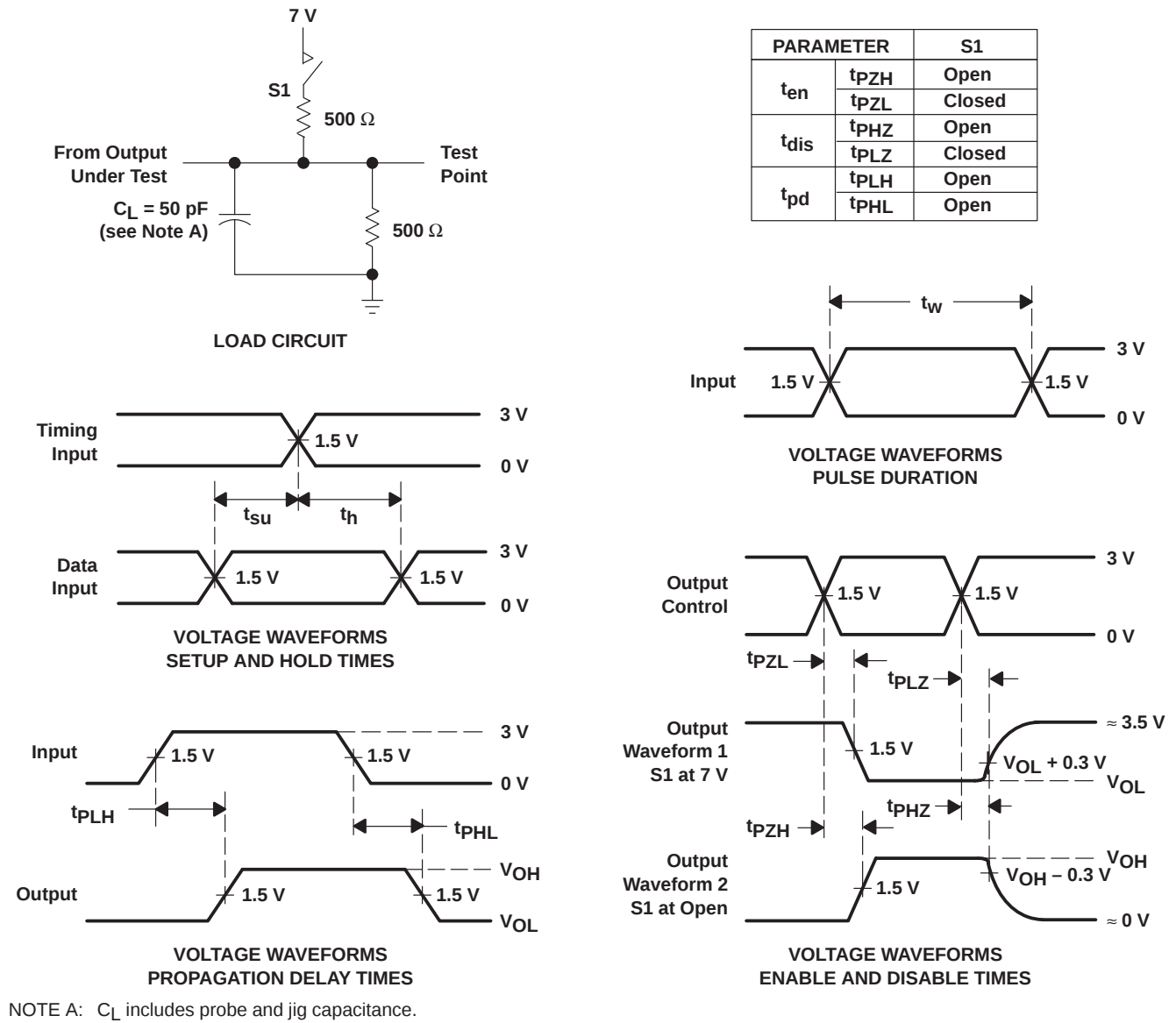


Figure 5. Load Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

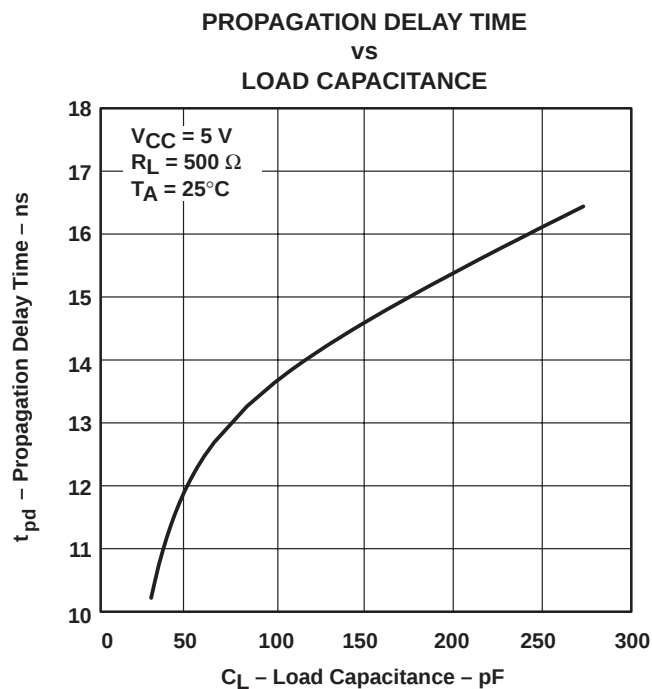


Figure 6

APPLICATION INFORMATION

expanding the SN74ACT7881

The SN74ACT7881 is expandable in both word width and word depth. Word-depth expansion is accomplished by connecting the devices in series such that data flows through each device in the chain. Figure 8 shows two SN74ACT7881 devices configured for word-depth expansion. The common clock between the devices can be tied to either the write clock (WRTCLK) of the first device or the read clock (RDCLK) of the last device. The output-ready (OR) flag of the previous device and the input-ready (IR) flag of the next device maintain data flow to the last device in the chain whenever space is available.

Figure 9 shows two SN74ACT7881 devices in word-width expansion. Word-width expansion is accomplished by simply connecting all common control signals between the devices and creating composite IR and OR signals. The almost-full/almost-empty (AF/AE) flag and half-full (HF) flag can be sampled from any one device. Word-depth expansion and word-width expansion can be used together.

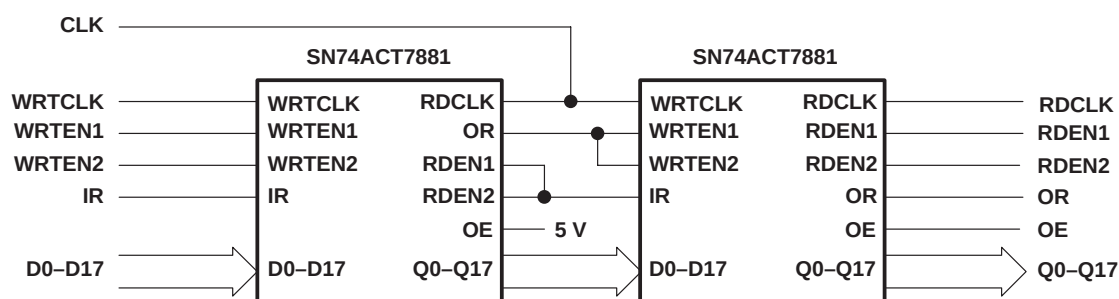


Figure 7. Word-Depth Expansion: 2048/4096/8192 × 18 Bits, N = 2

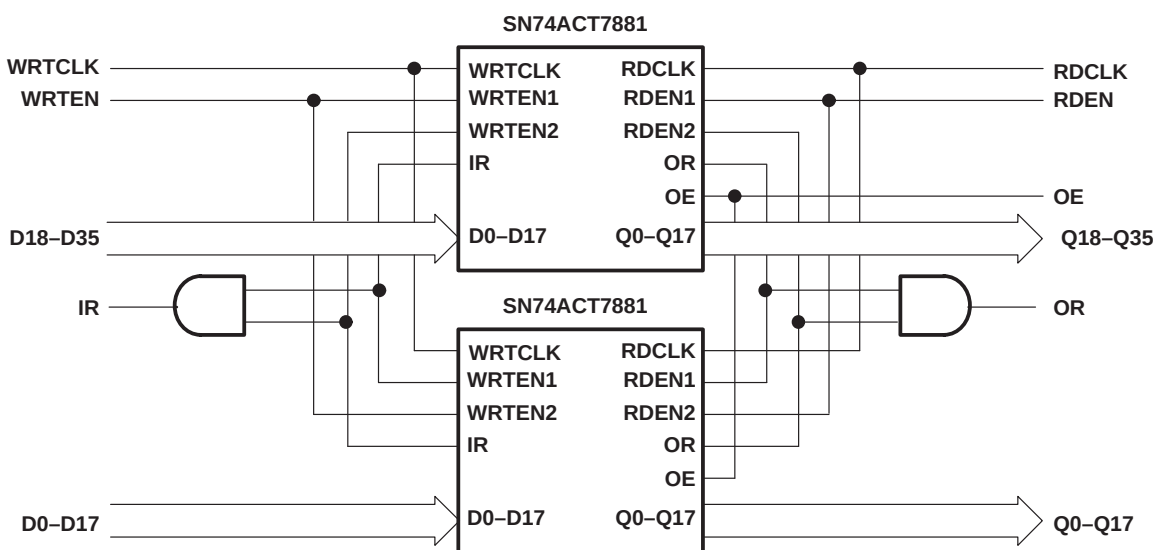


Figure 8. Word-Width Expansion: 1024 × 36 Bits

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
1M7881-20PNG4	ACTIVE	LQFP	PN	80	119	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT7881-15FN	ACTIVE	PLCC	FN	68	18	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT7881-15PN	ACTIVE	LQFP	PN	80	119	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT7881-20FN	ACTIVE	PLCC	FN	68	18	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT7881-20PN	ACTIVE	LQFP	PN	80	119	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT7881-30FN	ACTIVE	PLCC	FN	68	18	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT7881-30PN	ACTIVE	LQFP	PN	80	119	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR

⁽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.

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.

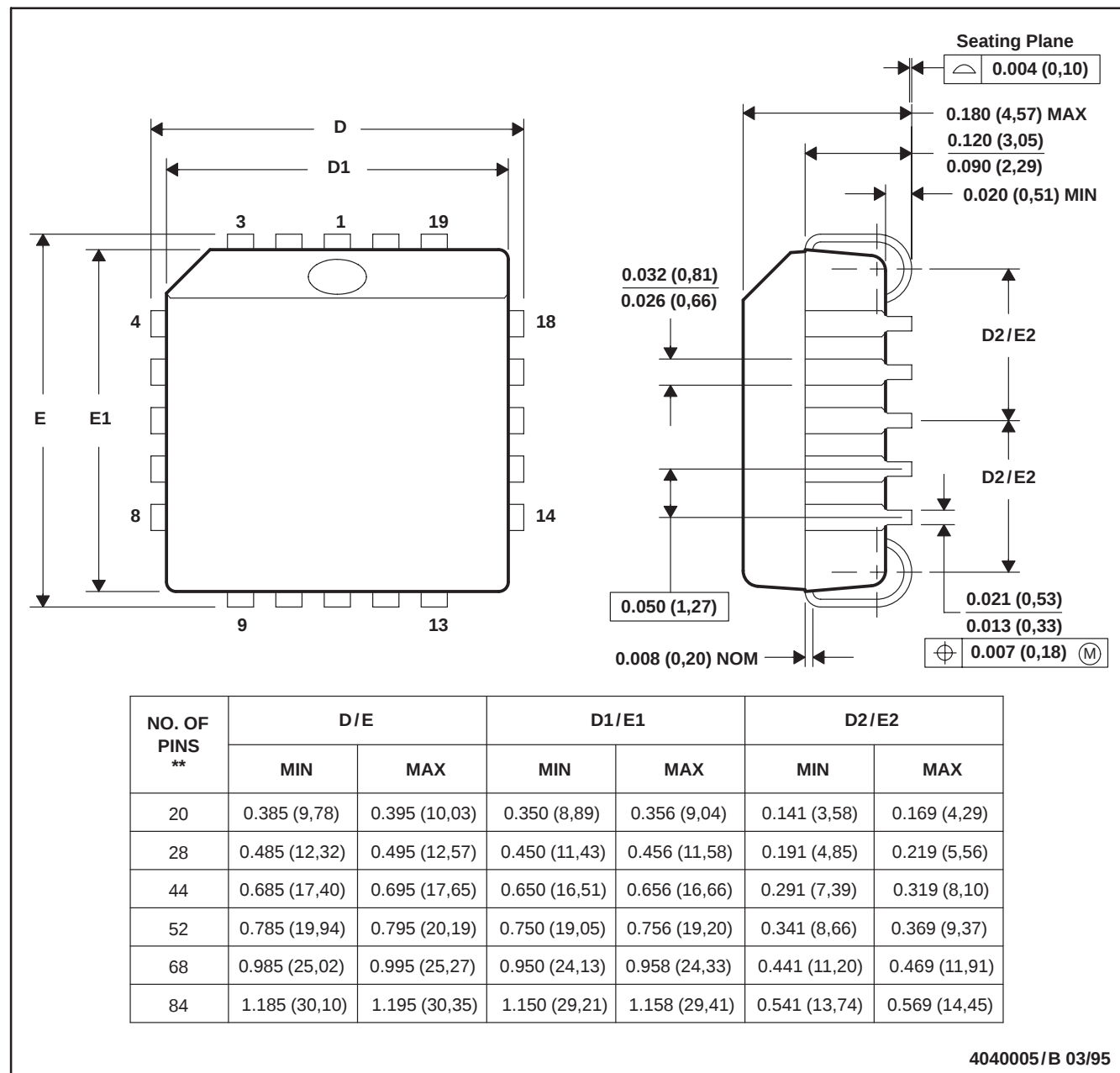
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FN (S-PQCC-J**)

PLASTIC J-LEADED CHIP CARRIER

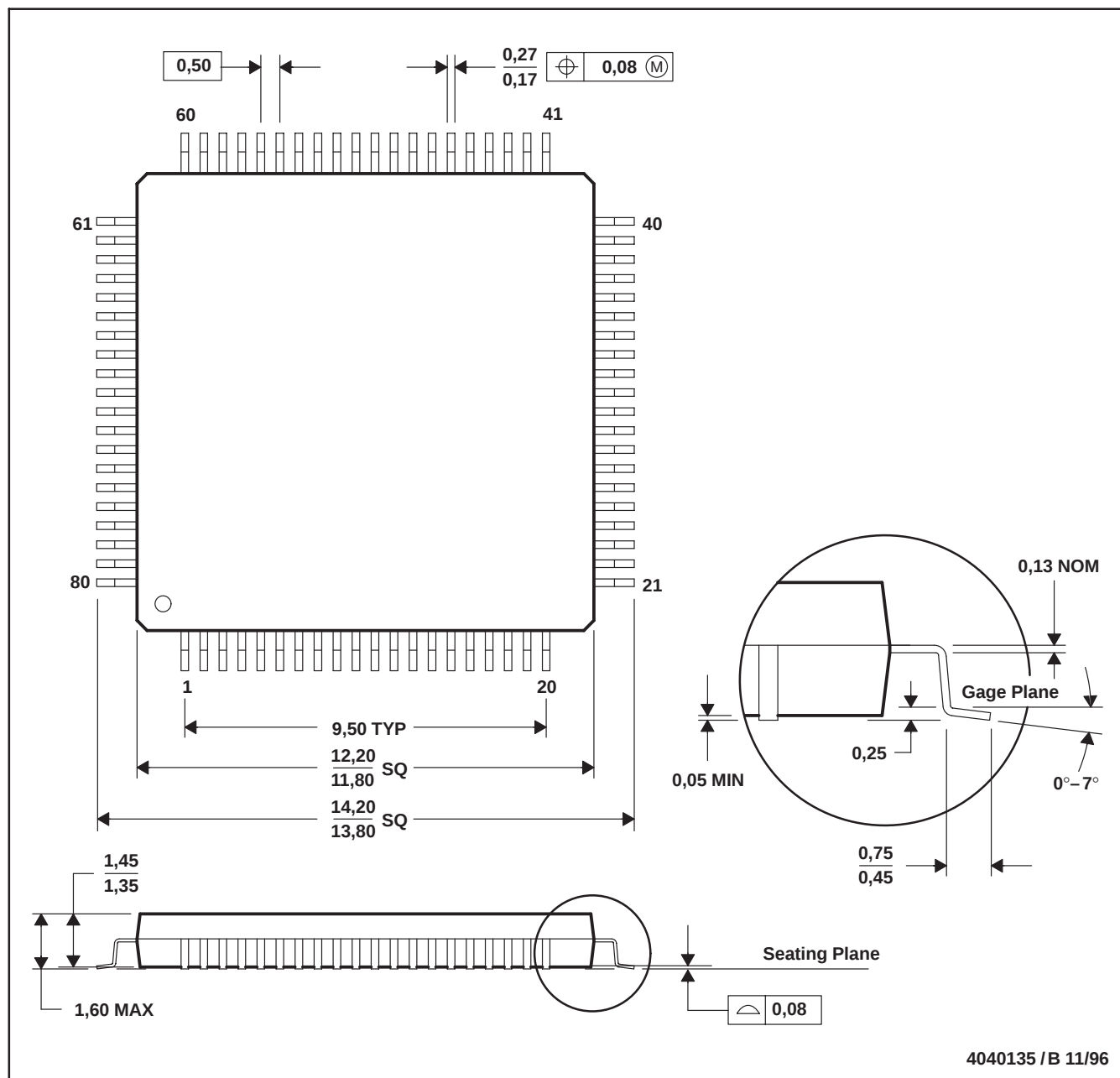
20 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-018

PN (S-PQFP-G80)

PLASTIC QUAD FLATPACK



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Mailing Address: Texas Instruments
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