

FEATURES

- Member of the Texas Instruments Widebus™ Family
- EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process
- Output Ports Have Equivalent $26\text{-}\Omega$ Series Resistors, So No External Resistors Are Required
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200 \text{ pF}$, $R = 0$)
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Package Options Include Plastic Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages

NOTE: For tape-and-reel order entry, the DGGR package is abbreviated to GR.

DESCRIPTION

This 10-bit flip-flop is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74ALVCH162820 flip-flops are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the device provides true data at the Q outputs.

A buffered output-enable (\overline{OE}) input can be used to place the ten outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components.

\overline{OE} does not affect the internal operations of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The outputs, which are designed to sink up to 12 mA, include equivalent $26\text{-}\Omega$ resistors to reduce overshoot and undershoot.

To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

The SN74ALVCH162820 is characterized for operation from -40°C to 85°C.

DGG OR DL PACKAGE (TOP VIEW)

\overline{OE}	1	56	CLK
1Q1	2	55	D1
1Q2	3	54	NC
GND	4	53	GND
2Q1	5	52	D2
2Q2	6	51	NC
V_{CC}	7	50	V_{CC}
3Q1	8	49	D3
3Q2	9	48	NC
4Q1	10	47	D4
GND	11	46	GND
4Q2	12	45	NC
5Q1	13	44	D5
5Q2	14	43	NC
6Q1	15	42	D6
6Q2	16	41	NC
7Q1	17	40	D7
GND	18	39	GND
7Q2	19	38	NC
8Q1	20	37	D8
8Q2	21	36	NC
V_{CC}	22	35	V_{CC}
9Q1	23	34	D9
9Q2	24	33	NC
GND	25	32	GND
10Q1	26	31	D10
10Q2	27	30	NC
\overline{OE}	28	29	NC

NC – No internal connection

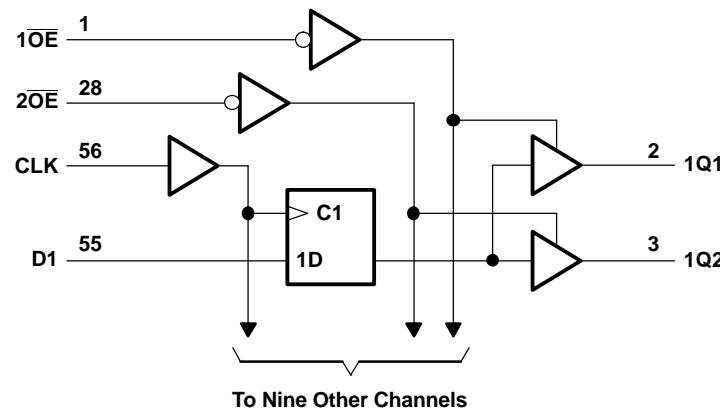


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FUNCTION TABLE
(each flip-flop)

INPUTS			OUTPUT
$\overline{OE}_n^{(1)}$	CLK	D	Q
L	↑	H	H
L	↑	L	L
L	L	X	Q_0
H	X	X	Z

(1) $n = 1, 2$
LOGIC DIAGRAM (POSITIVE LOGIC)

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	-0.5	4.6	V
V_I	Input voltage range ⁽²⁾	-0.5	4.6	V
V_O	Output voltage range ⁽²⁾⁽³⁾	-0.5	$V_{CC} + 0.5$	V
I_{IK}	Input clamp current $V_I < 0$	-	-50	mA
I_{OK}	Output clamp current $V_O < 0$	-	-50	mA
I_O	Continuous output current	-	± 50	mA
	Continuous current through each V_{CC} or GND	-	± 100	mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	DGG package		64
		DL package		56
T_{stg}	Storage temperature range	-65	150	°C

- (1) 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.
- (2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 4.6 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51.

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

		MIN	MAX	UNIT
V_{CC}	Supply voltage	1.65	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.65 \times V_{CC}$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2	
V_{IL}	Low-level input voltage	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0.7	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	0.8	
V_I	Input voltage	0	V_{CC}	V
V_O	Output voltage	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 1.65 \text{ V}$	-2	mA
		$V_{CC} = 2.3 \text{ V}$	-6	
		$V_{CC} = 2.7 \text{ V}$	-8	
		$V_{CC} = 3 \text{ V}$	-12	
I_{OL}	Low-level output current	$V_{CC} = 1.65 \text{ V}$	2	mA
		$V_{CC} = 2.3 \text{ V}$	6	
		$V_{CC} = 2.7 \text{ V}$	8	
		$V_{CC} = 3 \text{ V}$	12	
$\Delta t/\Delta v$	Input transition rise or fall rate		10	ns/V
T_A	Operating free-air temperature	-40	85	°C

(1) All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	V _{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{OH}	I _{OH} = -100 μ A	1.65 V to 3.6 V	V _{CC} - 0.2			V
	I _{OH} = -2 mA	1.65 V	1.2			
	I _{OH} = -4 mA	2.3 V	1.9			
	I _{OH} = -6 mA	2.3 V	1.7			
	I _{OH} = -8 mA	2.7 V	2			
	I _{OH} = -12 mA	3 V	2			
V _{OL}	I _{OL} = 100 μ A	1.65 V to 3.6 V		0.2		V
	I _{OL} = 2 mA	1.65 V		0.45		
	I _{OL} = 4 mA	2.3 V		0.4		
	I _{OL} = 6 mA	2.3 V		0.55		
	I _{OL} = 8 mA	3 V		0.55		
	I _{OL} = 12 mA	2.7 V		0.6		
I _I	V _I = V _{CC} or GND	3.6 V		\pm 5	μ A	
I _{I(hold)}	V _I = 0.58 V	1.65 V	25			μ A
	V _I = 1.07 V	1.65 V	-25			
	V _I = 0.7 V	2.3 V	45			
	V _I = 1.7 V	2.3 V	-45			
	V _I = 0.8 V	3 V	75			
	V _I = 2 V	3 V	-75			
	V _I = 0 to 3.6 V ⁽²⁾	3.6 V		\pm 500		
I _{OZ}	V _O = V _{CC} or GND	3.6 V		\pm 10	μ A	
I _{CC}	V _I = V _{CC} or GND	I _O = 0	3.6 V		40	μ A
ΔI_{CC}	One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND		3 V to 3.6 V		750	μ A
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	3.5		pF
	Data inputs			6		
C _o	Outputs	V _O = V _{CC} or GND	3.3 V		7	pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

TIMING REQUIREMENTS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 through Figure 3)

		V _{CC} = 1.8 V		V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency	(1)		150		150		150		MHz
t _w	Pulse duration, CLK high or low	(1)		3.3		3.3		3.3		ns
t _{su}	Setup time, data before CLK↑	(1)		1.7		1.8		1.4		ns
t _h	Hold time, data after CLK↑	(1)		1.1		1.1		1		ns

(1) This information was not available at the time of publication.

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 through Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$		$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	
			MIN	TYP	MIN	MAX	MIN	MAX	MIN	MAX
f_{max}			(1)		150		150		150	MHz
t_{pd}	CLK	Q	(1)		1	6.4		6.2	1	5.4
t_{en}	\overline{OE}	Q	(1)		1	6.9		6.8	1	5.6
t_{dis}	\overline{OE}	Q	(1)		1	6.2		5.5	1	5

(1) This information was not available at the time of publication.

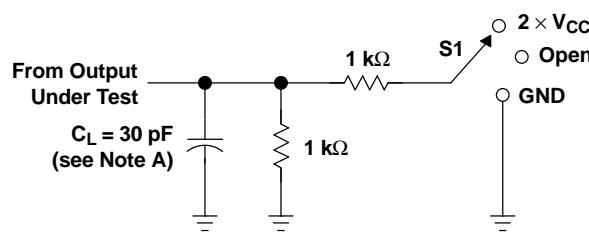
OPERATING CHARACTERISTICS

$T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
		TYP	TYP	TYP	
C_{pd} Power dissipation capacitance per flip-flop	All outputs enabled	(1)	68	66	pF
	All outputs disabled	$C_L = 50\text{ pF}, f = 10\text{ MHz}$	(1)	39	
				47	

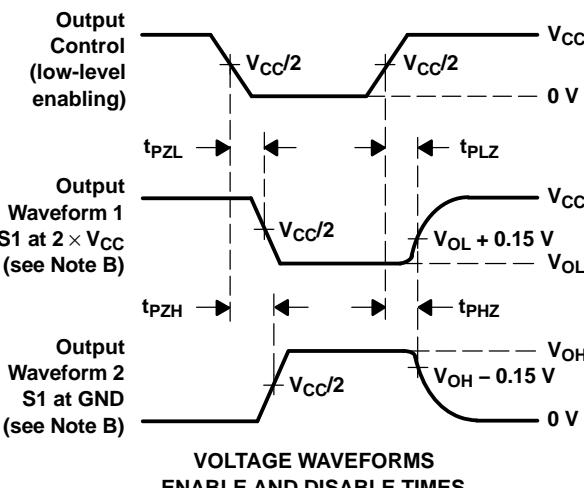
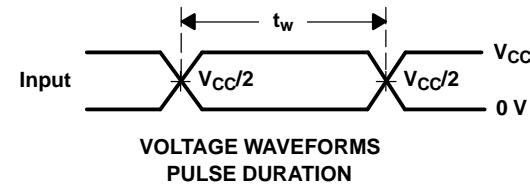
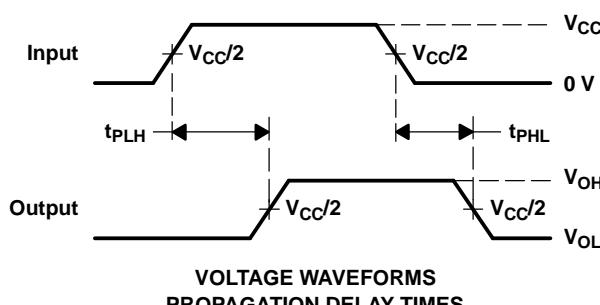
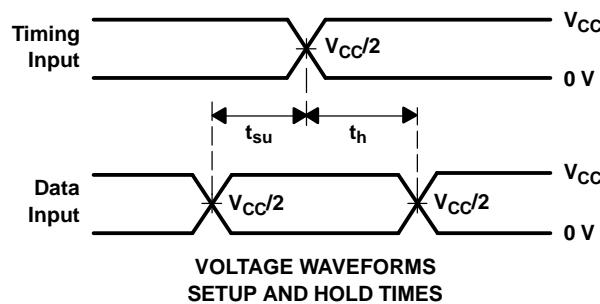
(1) This information was not available at the time of publication.

PARAMETER MEASUREMENT INFORMATION

 $V_{CC} = 1.8 \text{ V}$ 

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND

LOAD CIRCUIT

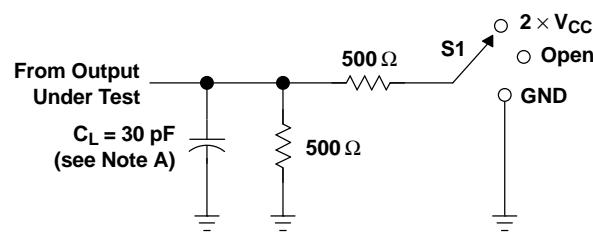


NOTES:

- C_L includes probe and jig capacitance.
- 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.
- All input pulses are supplied by generators having the following characteristics: PRR $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2 \text{ ns}$, $t_f \leq 2 \text{ ns}$.
- The outputs are measured one at a time, with one transition per measurement.
- t_{PLZ} and t_{PHZ} are the same as t_{dis} .
- t_{PZL} and t_{PZH} are the same as t_{en} .
- t_{PLH} and t_{PHL} are the same as t_{pd} .

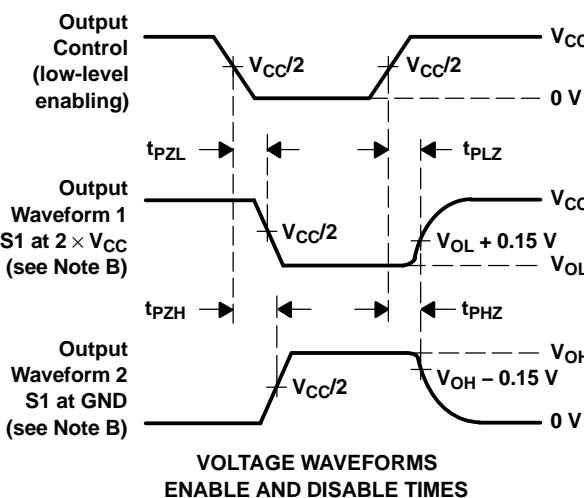
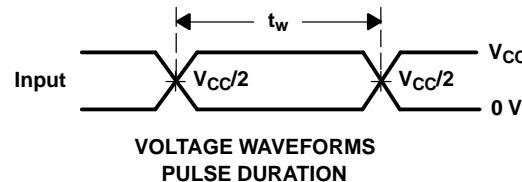
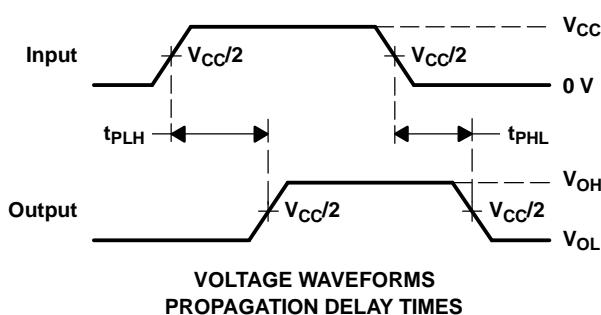
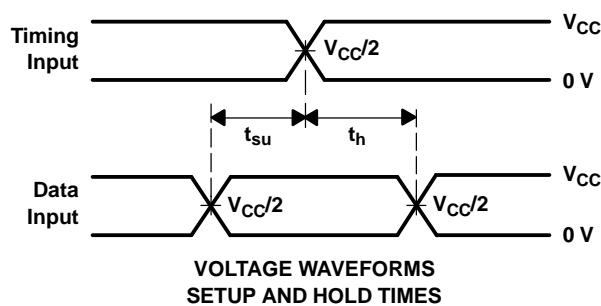
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$



TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND

LOAD CIRCUIT

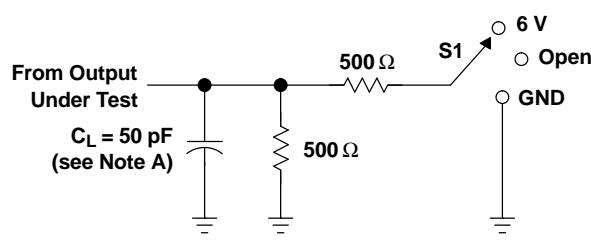


NOTES:

- C_L includes probe and jig capacitance.
- 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.
- All input pulses are supplied by generators having the following characteristics: PRR $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2 \text{ ns}$, $t_f \leq 2 \text{ ns}$.
- The outputs are measured one at a time, with one transition per measurement.
- t_{PLZ} and t_{PHZ} are the same as t_{dis} .
- t_{PZL} and t_{PZH} are the same as t_{en} .
- t_{PLH} and t_{PHL} are the same as t_{pd} .

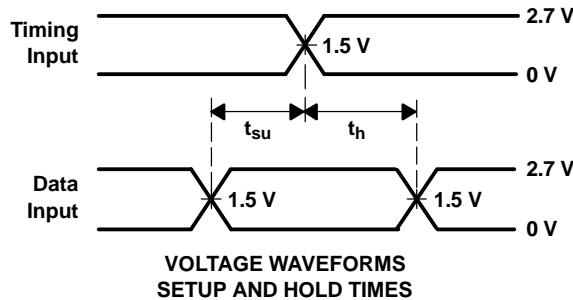
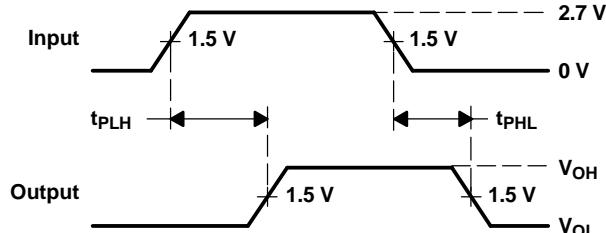
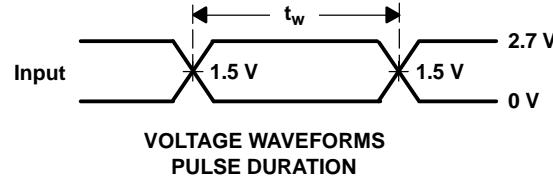
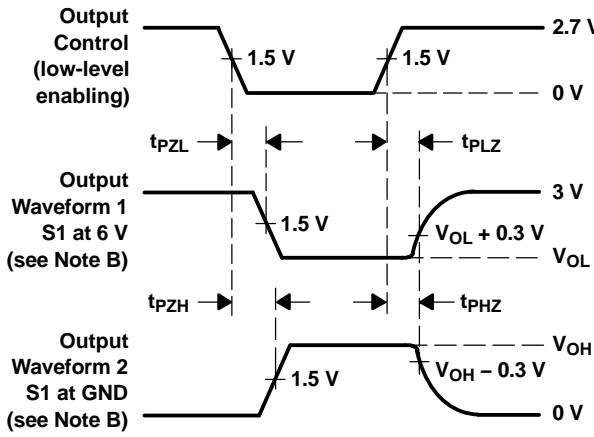
Figure 2. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

 $V_{CC} = 2.7 \text{ V AND } 3.3 \text{ V} \pm 0.3 \text{ V}$ 

LOAD CIRCUIT

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND

VOLTAGE WAVEFORMS
SETUP AND HOLD TIMESVOLTAGE WAVEFORMS
PROPAGATION DELAY TIMESVOLTAGE WAVEFORMS
PULSE DURATIONVOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMESNOTES: 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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
- D. The outputs are measured one at a time, with one transition per measurement.
- E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
- F. t_{PZL} and t_{PZH} are the same as t_{en} .
- G. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 3. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
74ALVCH162820DLG4	ACTIVE	SSOP	DL	56		TBD	Call TI	Call TI	-40 to 85	ALVCH162820	Samples
74ALVCH162820DLRG4	ACTIVE	SSOP	DL	56		TBD	Call TI	Call TI	-40 to 85	ALVCH162820	Samples
SN74ALVCH162820DGGR	OBsolete	TSSOP	DGG	56		TBD	Call TI	Call TI	-40 to 85		

(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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

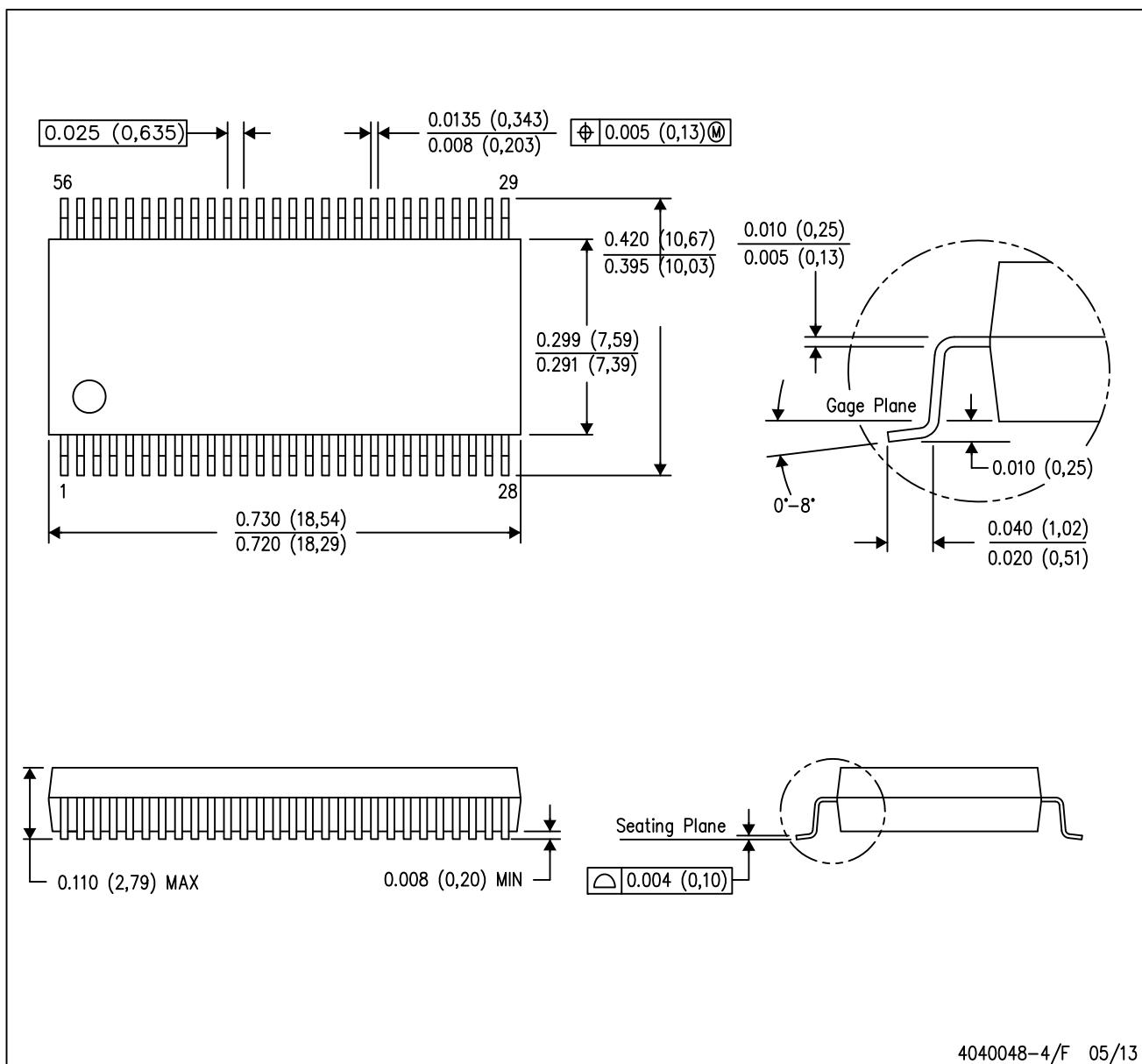
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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DL (R-PDSO-G56)

PLASTIC SMALL-OUTLINE PACKAGE



NOTES:

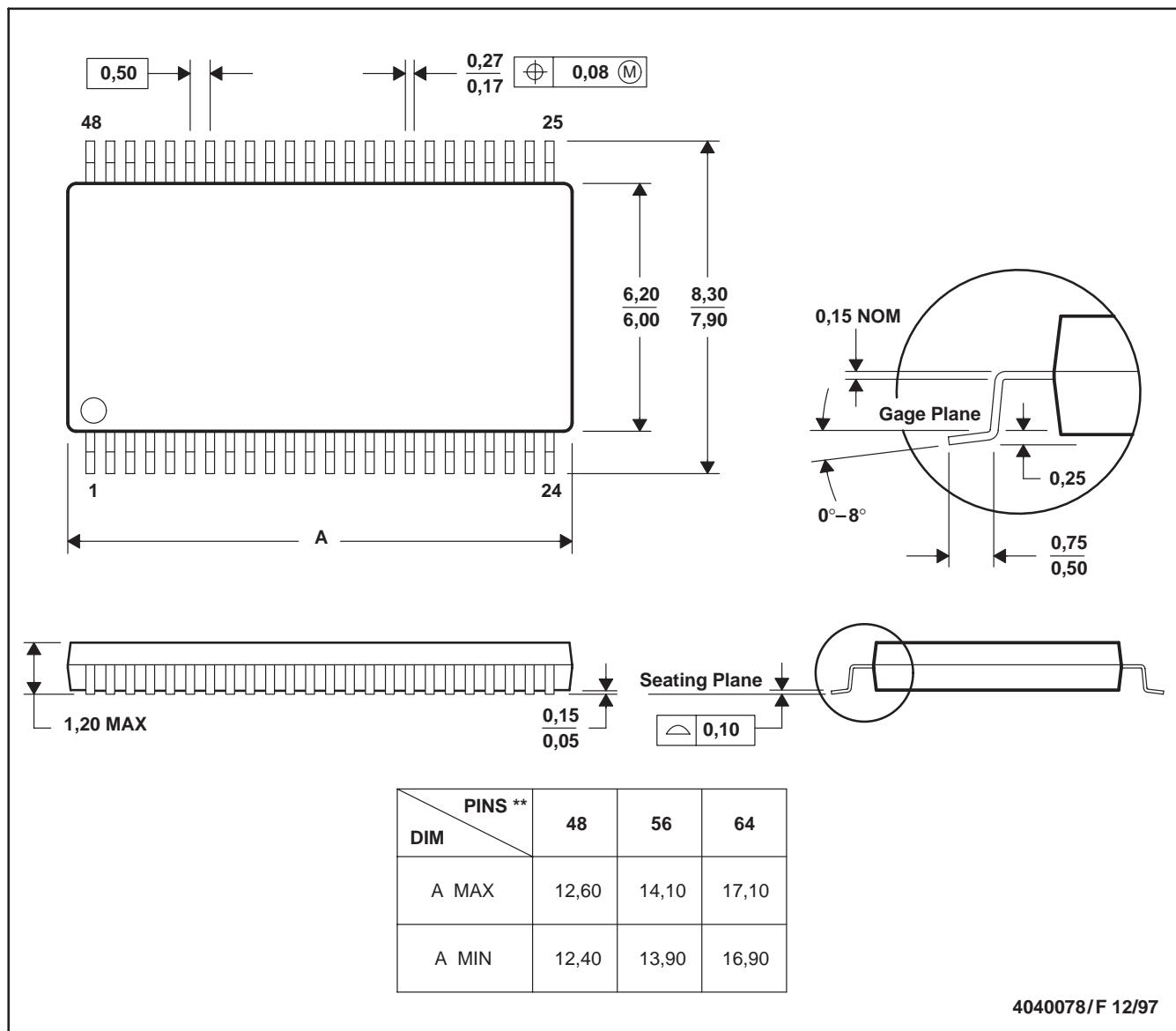
- All linear dimensions are in inches (millimeters).
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0.15).
- Falls within JEDEC MO-118

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DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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