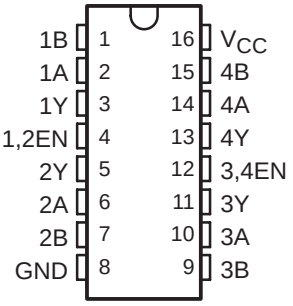
- **Meets or Exceeds the EIA Standards RS-422-A, RS-423-A, RS-485, and CCITT Recommendation V.11**
- **Designed to Operate With Pulse Durations as Short as 20 ns**
- **Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments**
- **Input Sensitivity . . . ±200 mV**
- **Low-Power Consumption . . . 20 mA Max**
- **Open-Circuit Fail-Safe Design**
- **Common-Mode Input Voltage Range of −7 V to 12 V**
- **Pin Compatible With SN75175 and LTC489**

D, DW, OR N PACKAGE
(TOP VIEW)



description

The SN65LBC175 and SN75LBC175 are monolithic, quadruple, differential line receivers with 3-state outputs designed to meet the requirements of the EIA standards RS-422-A, RS-423-A, RS-485, and CCITT Recommendation V.11. The devices are optimized for balanced multipoint bus transmission at data rates up to and exceeding 10 million bits per second. The receivers are enabled in pairs, with an active-high enable input. Each differential receiver input features high impedance, hysteresis for increased noise immunity, and sensitivity of ±200 mV over a common-mode input voltage range of 12 V to −7 V. The fail-safe design ensures that when the inputs are open-circuited, the outputs are always high. Both devices are designed using the TI proprietary LinBiCMOS™technology allowing low power consumption, high switching speeds, and robustness.

These devices offer optimum performance when used with the SN75LBC172 or SN75LBC174 quadruple line drivers. The SN65LBC175 is available in the 16-pin DIP (N), small-outline package (D), and the wide small-outline package (DW). The SN75LBC175 is available in the 16-pin DIP (N) and the small-outline package (D).

The SN65LBC175 is characterized over the industrial temperature range of −40°C to 85°C. The SN75LBC175 is characterized for operation over the commercial temperature range of 0°C to 70°C.

AVAILABLE OPTIONS

PACKAGE	TEMPERATURE RANGE	
	0°C to 70°C	−40°C to 85°C
SOIC	SN75LBC175D	SN65LBC175D
Wide SOIC	—	SN65LBC175DW
PDIP	SN75LBC175N	SN65LBC175N

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.

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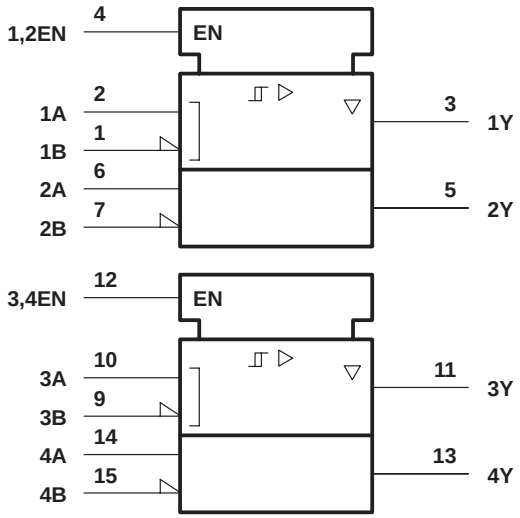
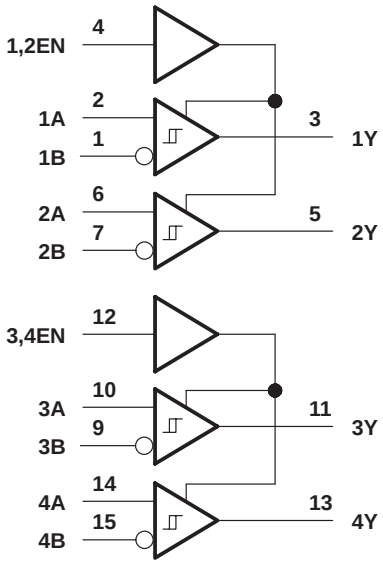
logic symbol†



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

logic diagram (positive logic)



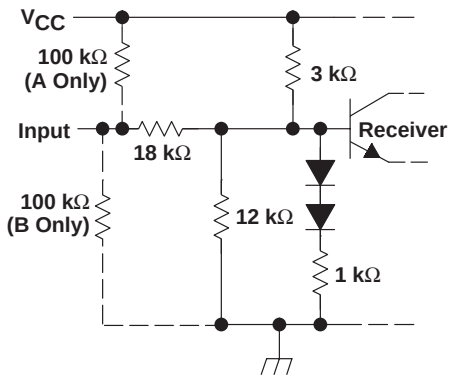
FUNCTION TABLE
(each receiver)

DIFFERENTIAL INPUTS A − B	ENABLE	OUTPUT Y
$V_{ID} \geq 0.2$ V	H	H
-0.2 V $< V_{ID} < 0.2$ V	H	?
$V_{ID} \leq -0.2$ V	H	L
X	L	Z
Open circuit	H	H

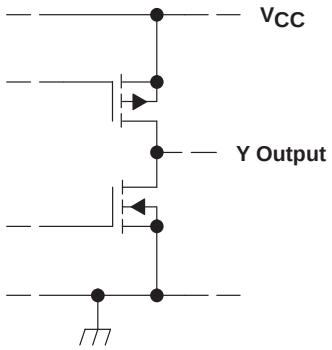
H = high level, L = low level, X = irrelevant,
Z = high impedance (off), ? = indeterminate

schematics of inputs and outputs

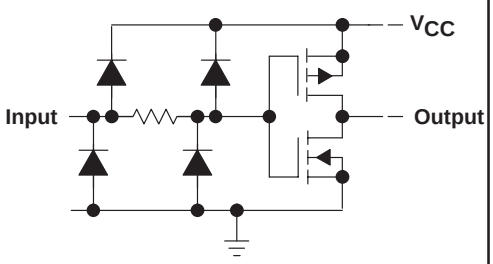
EQUIVALENT OF A AND B INPUTS



TYPICAL OF ALL OUTPUTS



TYPICAL OF EN INPUT



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

Supply voltage range, V_{CC} (see Note 1) . . . . . −0.3 V to 7 V
Input voltage, V_I (A or B inputs) . . . . . ±25 V
Differential input voltage, V_{ID} (see Note 2) . . . . . ±25 V
Voltage range at Y, 1/2EN, 3/4EN . . . . . −0.3 V to V_{CC} + 0.5 V
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: SN65LBC175 . . . . . −40°C to 85°C
SN75LBC175 . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°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. All voltage values are with respect to GND.
2. Differential input voltage is measured at the noninverting input with respect to the corresponding inverting input.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
D	1100 mW	8.7 mW/°C	709 mW	578 mW
DW	1200 mW	9.6 mW/°C	770 mW	625 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
Common-mode input voltage, V_{IC}		−7		12	V
Differential input voltage, V_{ID}				±6	V
High-level input voltage, V_{IH}	EN inputs	2			V
Low-level input voltage, V_{IL}	EN inputs			0.8	V
High-level output current, I_{OH}				−8	mA
Low-level output current, I_{OL}				8	mA
Operating free-air temperature, T_A	SN65LBC175	−40		85	°C
	SN75LBC175	0		70	

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER			TEST CONDITIONS			MIN	TYP†	MAX	UNIT
V_{IT+}	Positive-going input threshold voltage		I_O = −8 mA					0.2	V
V_{IT-}	Negative-going input threshold voltage		I_O = 8 mA			−0.2			V
V_{hys}	Hysteresis voltage ($V_{IT+} - V_{IT-}$)						45		mV
V_{IK}	Enable input clamp voltage		I_I = −18 mA				−0.9	−1.5	V
V_{OH}	High-level output voltage		V_{ID} = 200 mV,	I_{OH} = −8 mA		3.5	4.5		V
V_{OL}	Low-level output voltage		V_{ID} = −200 mV,	I_{OL} = 8 mA			0.3	0.5	V
I_{OZ}	High-impedance-state output current		V_O = 0 V to V_{CC}					±20	µA
I_I	Bus input current	A or B inputs	V_{IH} = 12 V,	V_{CC} = 5 V,	Other inputs at 0 V		0.7	1	mA
			V_{IH} = 12 V,	V_{CC} = 0 V,	Other inputs at 0 V		0.8	1	
			V_{IH} = −7 V,	V_{CC} = 5 V,	Other inputs at 0 V		−0.5	−0.8	
			V_{IH} = −7 V,	V_{CC} = 0 V,	Other inputs at 0 V		−0.4	−0.8	
I_{IH}	High-level enable input current		V_{IH} = 5 V					±20	µA
I_{IL}	Low-level enable input current		V_{IL} = 0 V					−20	µA
I_{OS}	Short-circuit output current		V_O = 0				−80	−120	mA
I_{CC}	Supply current		Outputs enabled,	I_O = 0,	V_{ID} = 5 V		11	20	mA
			Outputs disabled				0.9	1.4	

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

switching characteristics, V_{CC} = 5 V, C_L = 15 pF, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t_{PHL}	Propagation delay time, high- to low-level output	V_{ID} = −1.5 V to 1.5 V, See Figure 1	11	22	30	ns
t_{PLH}	Propagation delay time, low- to high-level output		11	22	30	ns
t_{PZH}	Output enable time to high level	See Figure 2		17	30	ns
t_{PZL}	Output enable time to low level	See Figure 3		18	30	ns
t_{PHZ}	Output disable time from high level	See Figure 2		30	40	ns
t_{PLZ}	Output disable time from low level	See Figure 3		23	30	ns
$t_{sk(p)}$	Pulse skew ($\lvert t_{PHL} - t_{PLH} \rvert$)	See Figure 2		4	6	ns
t_t	Transition time	See Figure 1		3	10	ns

PARAMETER MEASUREMENT INFORMATION

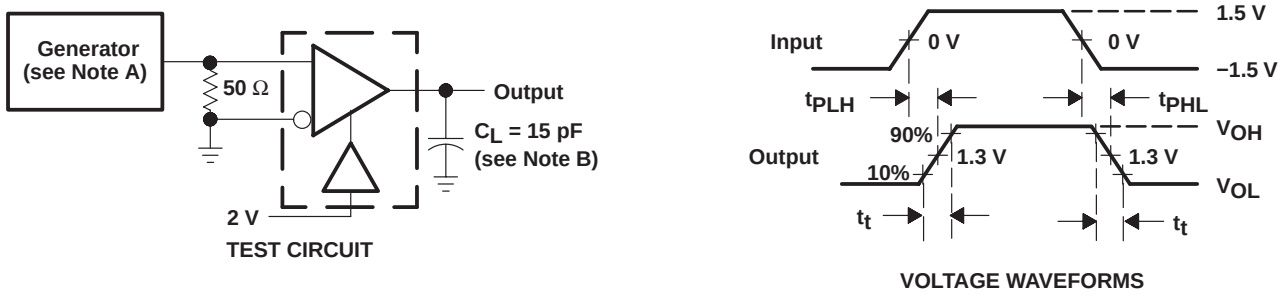
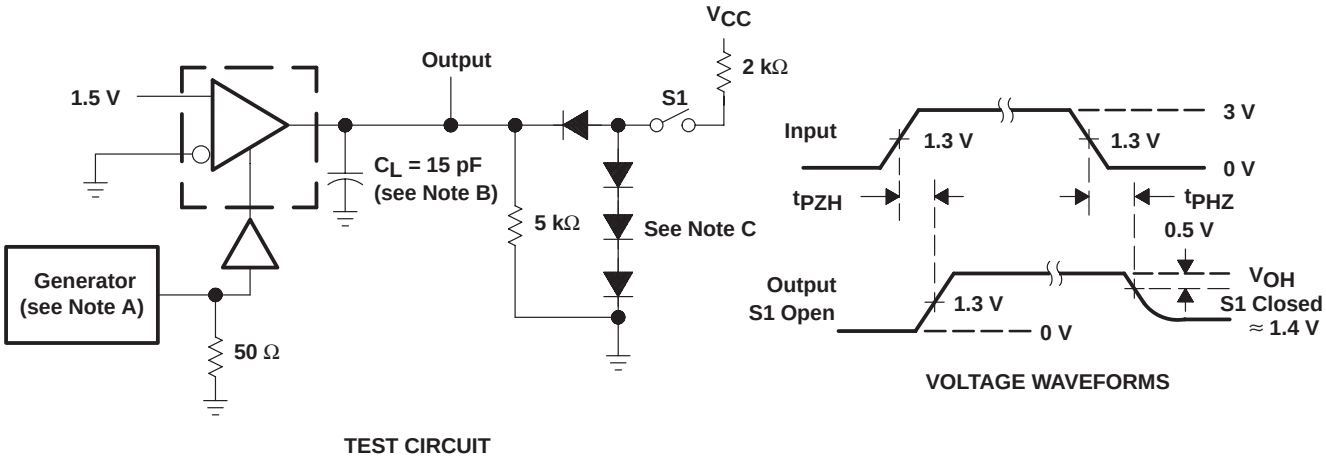


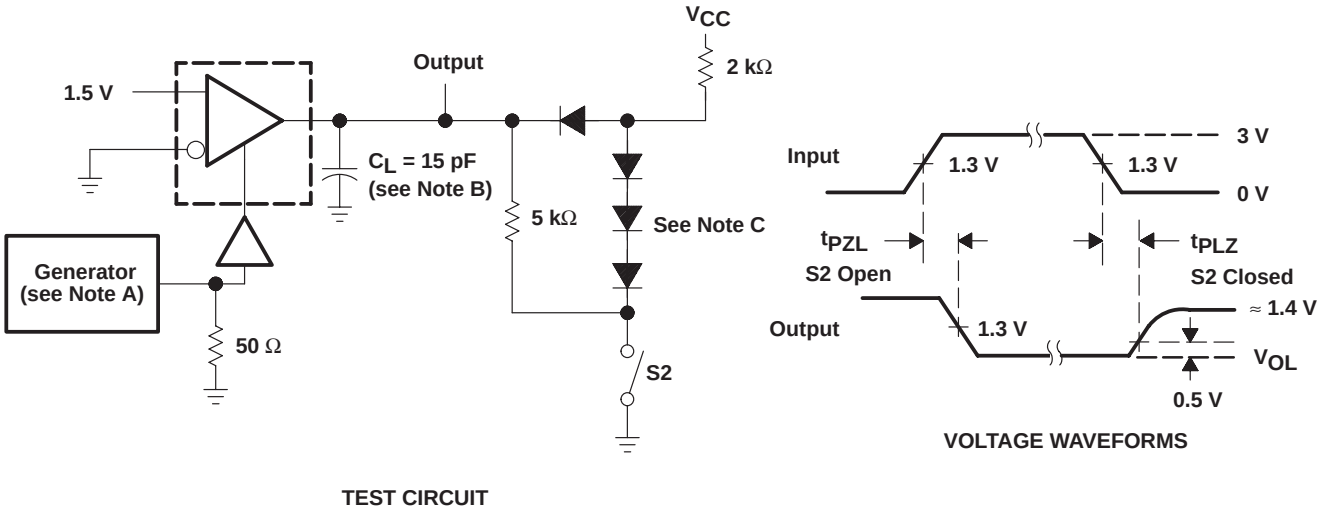
Figure 1. t_{PLH} and t_{PHL} Test Circuit and Voltage Waveforms



NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, duty cycle = 50%, $t_r \le 6$ ns, $t_f \le 6$ ns, $Z_O = 50\ \Omega$.
B. C_L includes probe and jig capacitance.
C. All diodes are 1N916 or equivalent.

Figure 2. t_{PHZ} and t_{PZH} Test Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION



NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, duty cycle = 50%, $t_r \le 6$ ns, $t_f \le 6$ ns, $Z_O = 50\ \Omega$.
B. C_L includes probe and jig capacitance.
C. All diodes are 1N916 or equivalent.

Figure 3. t_{PZL} and t_{PLZ} Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

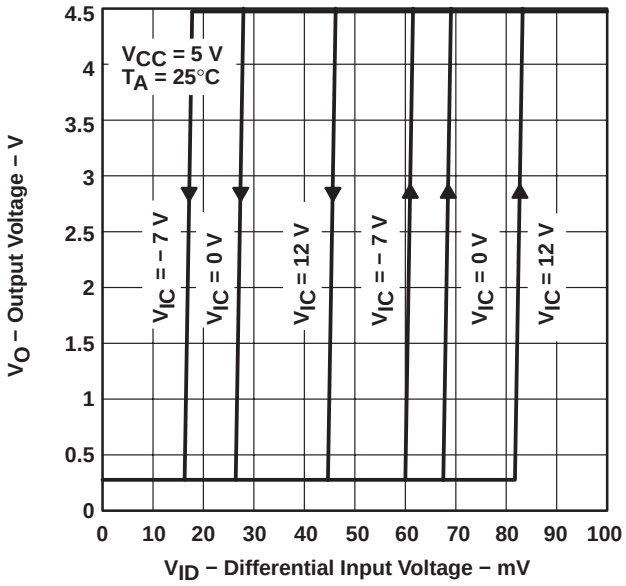


Figure 4

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

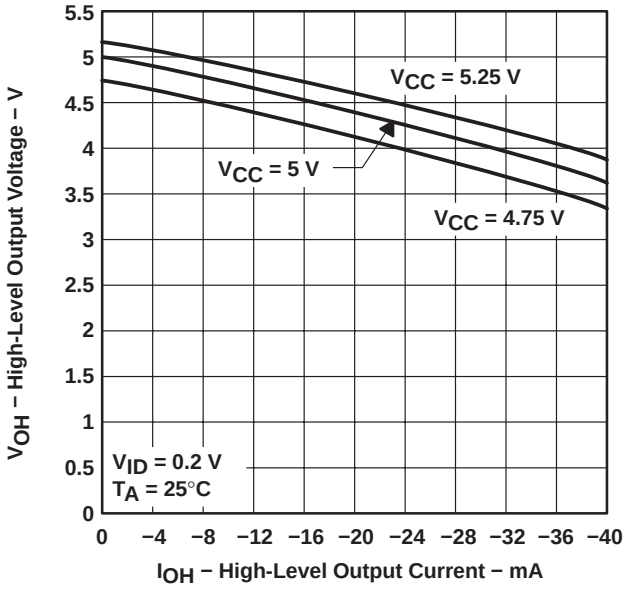


Figure 5

TYPICAL CHARACTERISTICS

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

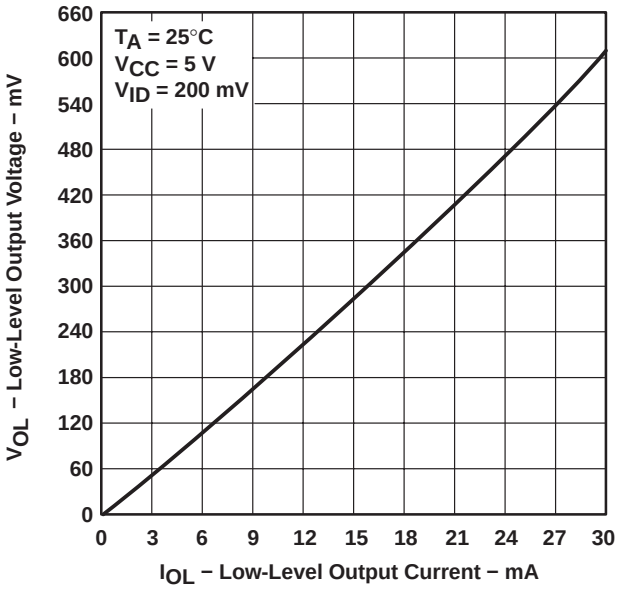


Figure 6

AVERAGE SUPPLY CURRENT vs FREQUENCY

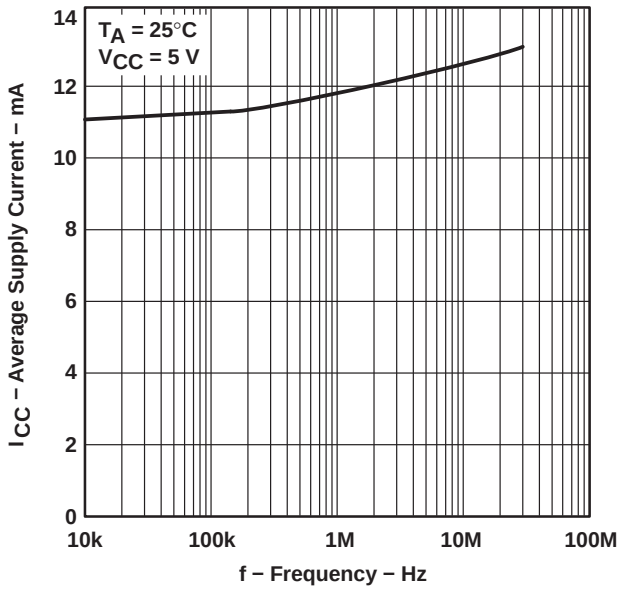


Figure 7

INPUT CURRENT vs INPUT VOLTAGE (COMPLEMENTARY INPUT AT 0 V)

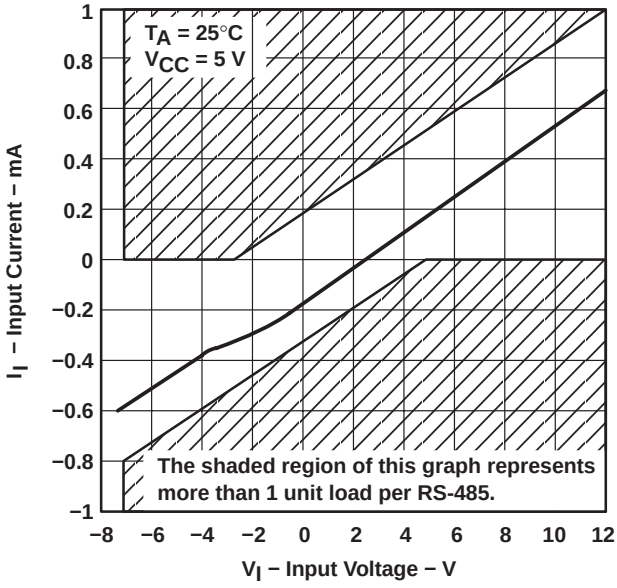


Figure 8

PROPAGATION DELAY TIME vs FREE-AIR TEMPERATURE

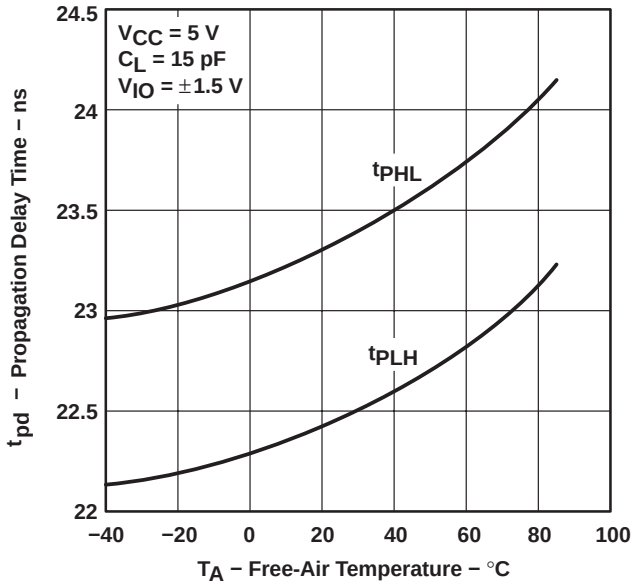
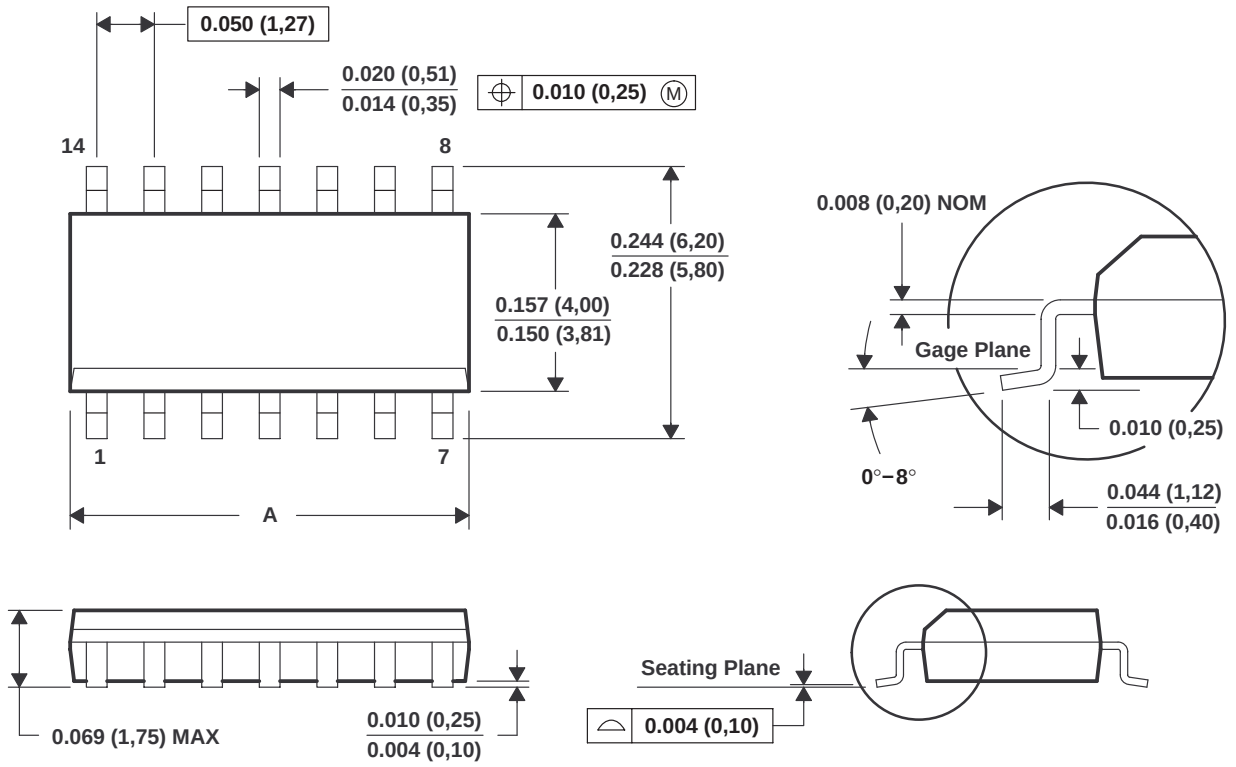


Figure 9

MECHANICAL DATA

D (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

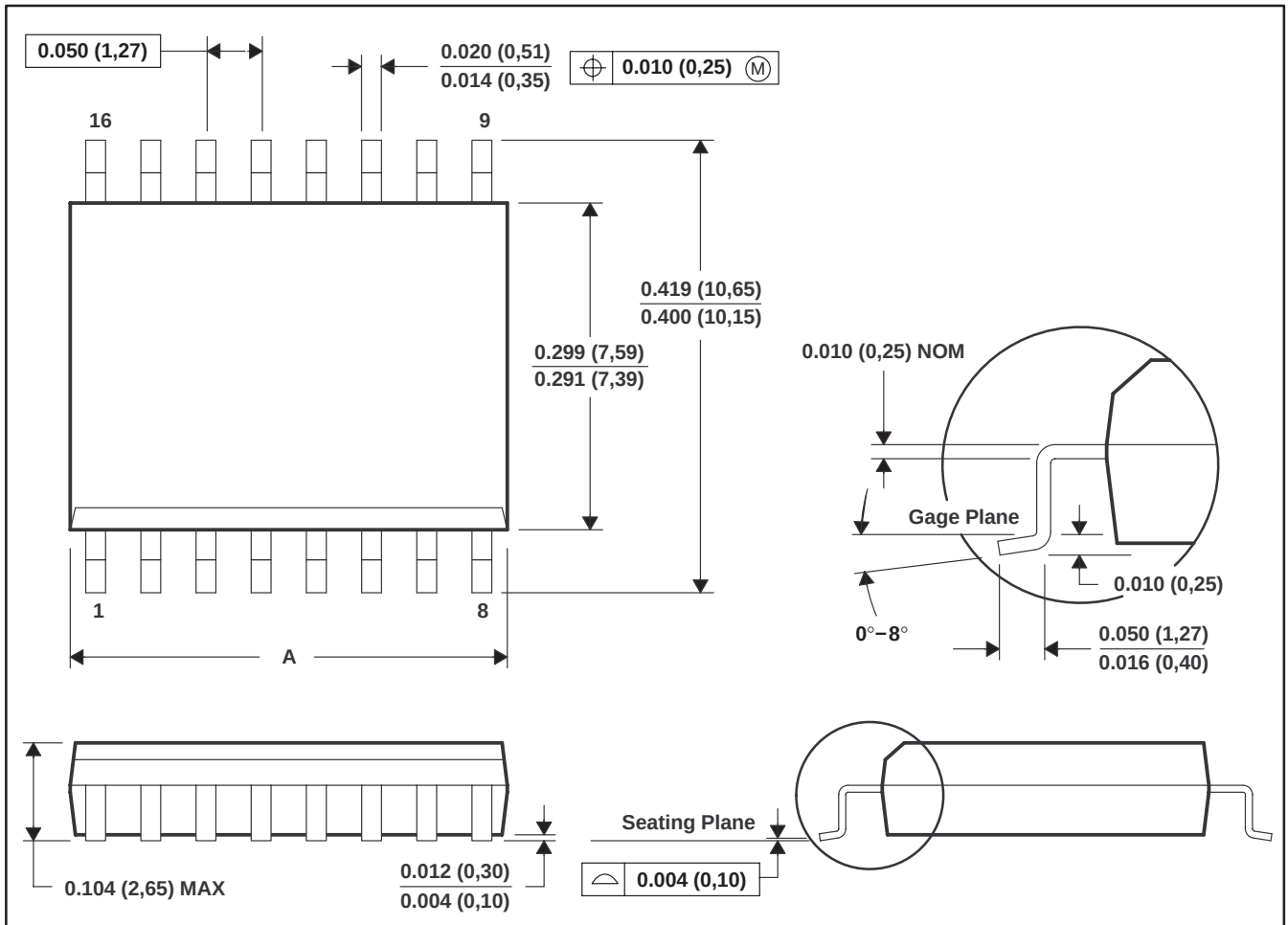
4040047/D 10/96

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 MS-012

MECHANICAL DATA

DW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

16 PINS SHOWN



DIM \ PINS **	16	18	20	24	28
A MAX	0.410 (10,41)	0.462 (11,73)	0.510 (12,95)	0.610 (15,49)	0.710 (18,03)
A MIN	0.400 (10,16)	0.453 (11,51)	0.500 (12,70)	0.600 (15,24)	0.700 (17,78)

4040000 / E 08/01

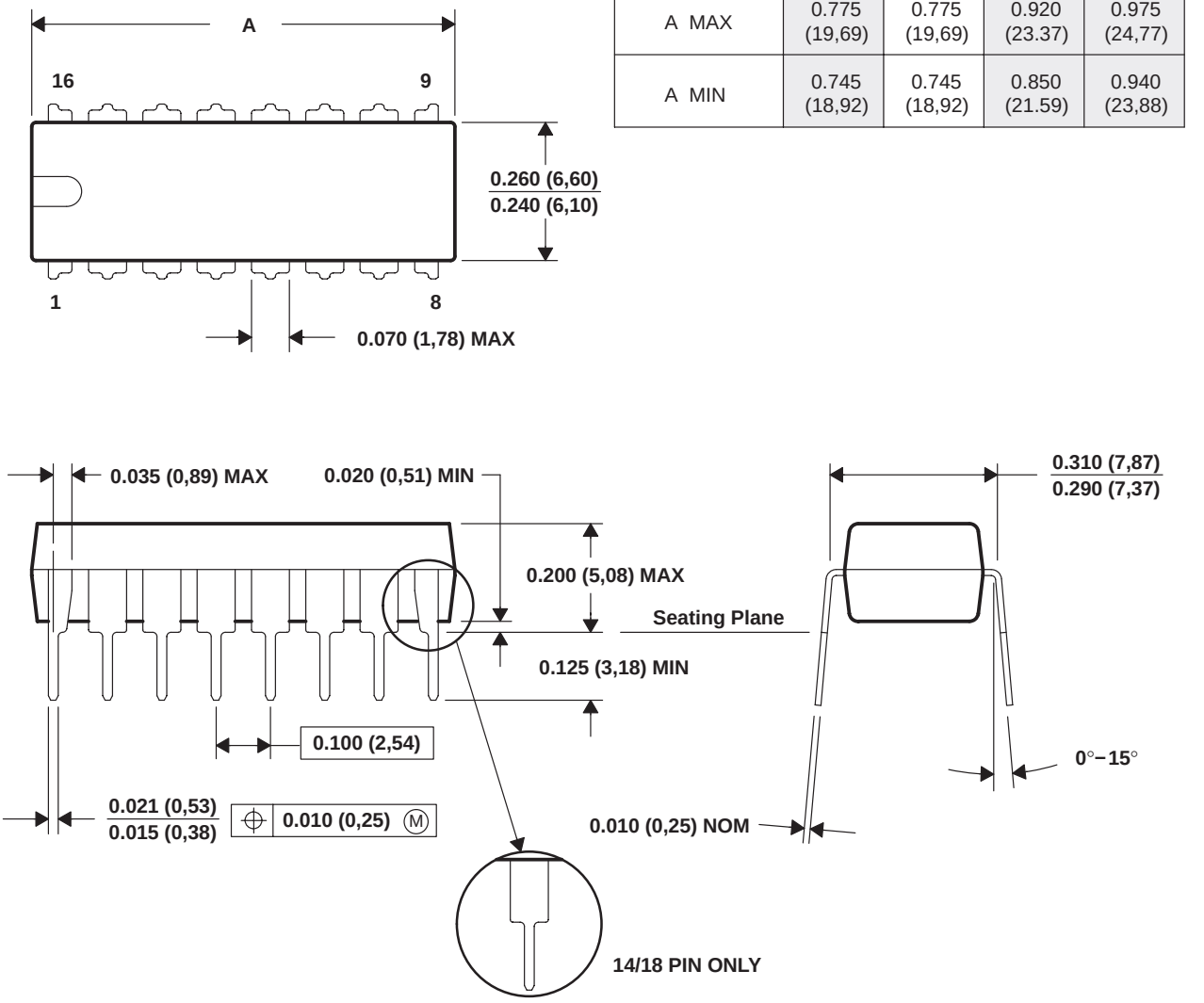
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-013

MECHANICAL DATA

N (R-PDIP-T)** **PLASTIC DUAL-IN-LINE PACKAGE**

16 PIN SHOWN

DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23.37)	0.975 (24,77)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21.59)	0.940 (23,88)



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 (20 pin package is shorter then MS-001.)

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
SN65LBC175D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175DWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN65LBC175NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC175D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC175NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

[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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OTHER QUALIFIED VERSIONS OF SN75LBC175 :

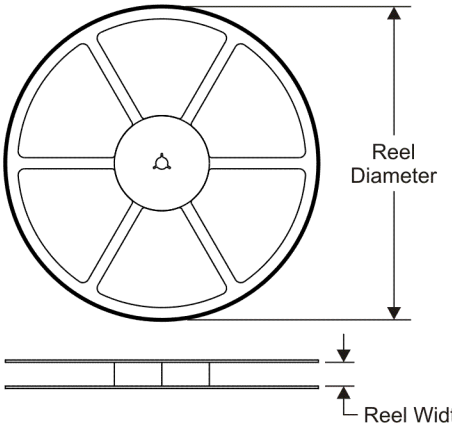
- Military: SN55LBC175

NOTE: Qualified Version Definitions:

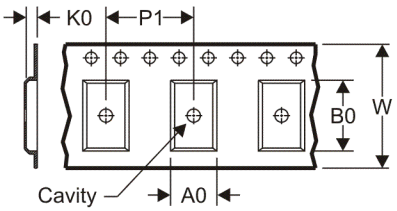
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

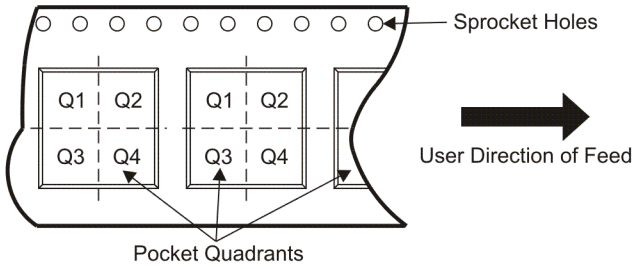


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

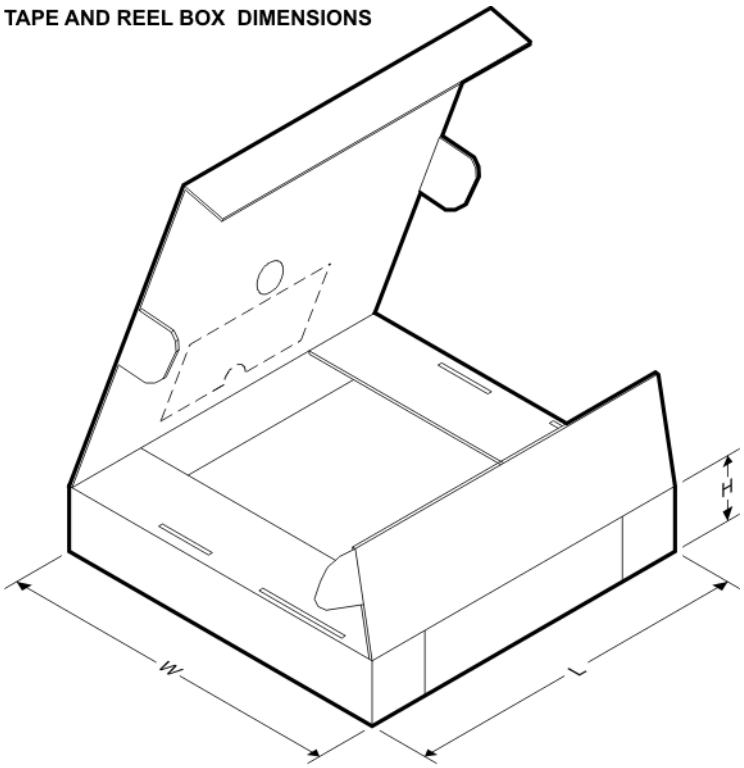
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65LBC175DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LBC175DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LBC175DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
SN75LBC175DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN75LBC175DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LBC175DR	SOIC	D	16	2500	333.2	345.9	28.6
SN65LBC175DR	SOIC	D	16	2500	346.0	346.0	33.0
SN65LBC175DWR	SOIC	DW	16	2000	346.0	346.0	33.0
SN75LBC175DR	SOIC	D	16	2500	333.2	345.9	28.6
SN75LBC175DR	SOIC	D	16	2500	346.0	346.0	33.0

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