

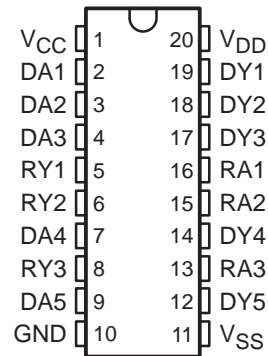
SN75LP196

LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

SLLS294A – APRIL 1998 – REVISED JUNE 1999

- **Single-Chip RS-232 Interface for an External Modem or Other Computer Peripheral Serial Port**
- **Designed to Transmit and Receive 4- μ s Pulses (Equivalent to 256 kbit/s)**
- **Wide Driver Supply-Voltage Range: 4.75 V to 15 V**
- **Driver Output Slew Rates Are Controlled Internally to 30 V/ μ s Maximum**
- **Receiver Input Hysteresis . . . 1000 mV Typical**
- **RS-232 Bus-Pin ESD Protection Exceeds 15 kV Using Human-Body Model (HBM)**
- **Five Drivers and Three Receivers Meet or Exceed the Requirements of TIA/EIA-232-F and ITU v.28 Standards**
- **Complements the SN75LP1185**
- **Designed to Replace the Industry-Standard SN75196 With the Same Flow-Through Pinout**
- **Package Options Include Plastic Small Outline (DW), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), and Dual-in-Line (N) Packages**

**DB, DW, N, OR PW PACKAGE
(TOP VIEW)**



description

The SN75LP196 is a low-power bipolar device containing five drivers and three receivers, with 15 kV of ESD protection on the bus pins with respect to each other. Bus pins are defined as those pins that tie directly to the serial-port connector, including GND. The pinout matches the flow-through design of the industry-standard SN75196 and allows easy interconnection of the UART and serial-port connector of the IBM PC/AT and compatibles. This device provides a rugged, low-cost solution for this function with the combination of bipolar processing and 15-kV ESD protection.

The SN75LP196 has internal slew-rate control to provide a maximum rate of change in the output signal of 30 V/ μ s. The driver output swing is clamped nominally at ± 6 V to enable the higher data rates associated with this device and to reduce EMI emissions. Even though the driver outputs are clamped, they can handle voltages up to ± 15 V without damage. All the logic inputs can accept 3.3-V or 5-V input signals.

The SN75LP196 complies with the requirements of the TIA/EIA-232-F and the ITU v.28 standards. These standards are for data interchange between a host computer and peripheral at signaling rates up to 20 kbit/s. The switching speeds of the SN75LP196 support rates up to 256 kbit/s with lower capacitive loads (shorter cables).

The SN75LP196 is characterized for operation from 0°C to 70°C.



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Function Tables

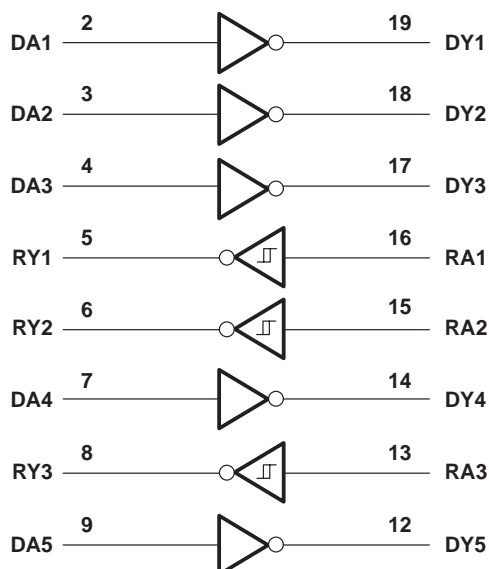
DRIVER

INPUT DA	OUTPUT DY
H	L
L	H
Open	L

RECEIVER

INPUT RA	OUTPUT RY
H	L
L	H
Open	H

logic diagram (positive logic)



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

Positive supply-voltage range (see Note 1): V_{CC}	–0.5 V to 7 V
V_{DD} (see Note 1)	–0.5 V to 15 V
Negative supply-voltage range, V_{SS} (see Note 1)	0.5 V to –15 V
Input-voltage range, V_I : Receiver (RA)	–30 V to 30 V
Driver (DA)	–0.5 V to $V_{CC}+0.4$ V
Output-voltage range, V_O : Receiver (RY)	–0.5 V to 6 V
Driver (DY)	–15 V to 15 V
Electrostatic discharge: Bus pins (human-body model) (see Note 2)	Class 3, A: 15 kV
All pins (human-body model) (see Note 2)	Class 3, A: 5 kV
All pins (machine model)	200 V
Package thermal impedance, θ_{JA} (see Notes 3 and 4): DB package	115°C/W
DW package	97°C/W
N package	67°C/W
PW package	128°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
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.

- NOTES:
1. All voltage values are with respect to network ground terminal, unless otherwise noted.
 2. Per MIL-STD-883 Method 3015.7
 3. Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
 4. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

		MIN	NOM	MAX	UNIT	
V_{CC}	Supply voltage (see Note 5)	4.75	5	5.25	V	
V_{DD}	Supply voltage (see Note 6)	9	12	15	V	
V_{SS}	Supply voltage (see Note 6)	–9	–12	–15	V	
V_{IH}	High-level input voltage		DA	2	V	
V_{IL}	Low-level input voltage		DA	0.8	V	
V_I	Receiver input voltage		RA	–25	25	V
I_{OH}	High-level output current		RY	–1	mA	
I_{OL}	Low-level output current		RY	2	mA	
T_A	Operating free-air temperature	0		70	°C	

- NOTES:
5. V_{CC} cannot be greater than V_{DD} .
 6. The device operates down to $V_{DD} = V_{CC}$ and $|V_{SS}| = V_{CC}$, but supply currents increase and other parameters may vary slightly from the data-sheet limits.

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supply currents over the recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current for V_{CC} , I_{CC}	$V_{DD} = 9\text{ V}$, $V_{SS} = -9\text{ V}$			1000	μA
	$V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$			1000	
Supply current for V_{DD} , I_{DD}	$V_{DD} = 9\text{ V}$, $V_{SS} = -9\text{ V}$			800	μA
	$V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$			800	
Supply current for V_{SS} , I_{SS}	$V_{DD} = 9\text{ V}$, $V_{SS} = -9\text{ V}$			-800	μA
	$V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$			-800	

driver electrical characteristics over the recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
V_{OH} High-level output voltage	$V_{IL} = 0.8\text{ V}$, $R_L = 3\text{ k}\Omega$, See Figure 1	$V_{DD} = 9\text{ V}$, $V_{SS} = -9\text{ V}$, See Note 7	5	5.8	6.6	V
		$V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$, See Note 8	5	5.8	6.6	
V_{OL} Low-level output voltage	$V_{IH} = 2\text{ V}$, $R_L = 3\text{ k}\Omega$, See Figure 1	$V_{DD} = 9\text{ V}$, $V_{SS} = -9\text{ V}$, See Note 7	-5	-5.8	-6.9	V
		$V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$, See Note 8	-5	-5.8	-6.9	
I_{IH} High-level input current	V_I at V_{CC}			1	μA	
I_{IL} Low-level input current	V_I at GND			-1	μA	
$I_{OS(H)}$ Short-circuit high-level output current	$V_O = \text{GND}$ or V_{SS} . See Figure 2 and Note 9		-30	-55	mA	
$I_{OS(L)}$ Short-circuit low-level output current	$V_O = \text{GND}$ or V_{DD} . See Figure 2 and Note 9		30	55	mA	
r_o Output resistance	$V_{DD} = V_{SS} = V_{CC} = 0$, $V_O = -2\text{ V}$ to 2 V	300			Ω	

- NOTES: 7. Minimum RS-232 driver output voltages are not attained with $\pm 5\text{-V}$ supplies. With V_{DD} less than $V_{CC} + 2\text{ V}$, the supply currents may increase. For RS-232 compliant output swings and minimum power consumption, $V_{DD} \geq V_{CC} + 2\text{ V}$.
8. Maximum output swing is nominally clamped at $\pm 6\text{ V}$ to enable the higher data rates associated with this device and to reduce EMI emissions. The driver outputs may slightly exceed the maximum output voltage over the full V_{CC} and temperature ranges.
9. Not more than one output should be shorted at one time.

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT		
t_{PHL}	Propagation delay time, high- to low-level output	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 15\text{ pF}$, See Figure 1	300	800	1600	ns		
t_{PLH}	Propagation delay time, low- to high-level output	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 15\text{ pF}$, See Figure 1	300	800	1600	ns		
t_{TLH}	Transition time, low- to high-level output	$V_{CC} = 5\text{ V}$, $V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$, $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, See Figure 1 and Note 10	Using $V_{TR} = 10\%$ -to- 90% transition region, Driver speed = 250 kbit/s, $C_L = 15\text{ pF}$		375	2240	ns	
			Using $V_{TR} = \pm 3\text{ V}$ transition region, Driver speed = 250 kbit/s, $C_L = 15\text{ pF}$		200	1500		
			Using $V_{TR} = \pm 3\text{ V}$ transition region, Driver speed = 125 kbit/s, $C_L = 2500\text{ pF}$			2750		
t_{THL}	Transition time, high- to low-level output	$V_{CC} = 5\text{ V}$, $V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$, $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, See Figure 1 and Note 10	Using $V_{TR} = 10\%$ -to- 90% transition region, Driver speed = 250 kbit/s, $C_L = 15\text{ pF}$		375	2240	ns	
			Using $V_{TR} = \pm 3\text{ V}$ transition region, Driver speed = 250 kbit/s, $C_L = 15\text{ pF}$		200	1500		
			Using $V_{TR} = \pm 3\text{ V}$ transition region, Driver speed = 125 kbit/s, $C_L = 2500\text{ pF}$			2750		
SR	Output slew rate	$V_{CC} = 5\text{ V}$, $V_{DD} = 12\text{ V}$, $V_{SS} = -12\text{ V}$,	Using $V_{TR} = \pm 3\text{ V}$ transition region, Driver speed = 0 to 250 kbit/s, $C_L = 15\text{ pF}$		4	20	30	V/ μ s

NOTE 10: Maximum output swing is limited to $\pm 6\text{ V}$ to enable the higher data rates associated with this device and to reduce EMI emissions.

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IT+}	Positive-going input threshold voltage	See Figure 3	1.6	2	2.55	V
V_{IT-}	Negative-going input threshold voltage	See Figure 3	0.6	1	1.45	V
V_{HYS}	Input hysteresis, $V_{IT+} - V_{IT-}$	See Figure 3	750	1000		mV
V_{OH}	High-level output voltage	$I_{OH} = -1\text{ mA}$	2.5	3.9		V
V_{OL}	Low-level output voltage	$I_{OL} = 2\text{ mA}$		0.33	0.5	V
I_{IH}	High-level input current	$V_I = 3\text{ V}$	0.43	0.6	1	mA
		$V_I = 25\text{ V}$	3.6	5.1	8.3	
I_{IL}	Low-level input current	$V_I = 3\text{ V}$	-0.43	-0.6	-1	mA
		$V_I = 25\text{ V}$	-3.6	-5.1	-8.3	
$I_{OS(H)}$	Short-circuit high-level output current	$V_O = 0$, See Figure 5 and Note 9			-20	mA
$I_{OS(L)}$	Short-circuit low-level output current	$V_O = V_{CC}$, See Figure 5 and Note 9			20	mA
R_{IN}	Input resistance	$V_I = \pm 3\text{ V}$ to $\pm 25\text{ V}$	3	5	7	k Ω

NOTE 9: Not more than one output should be shorted at one time.

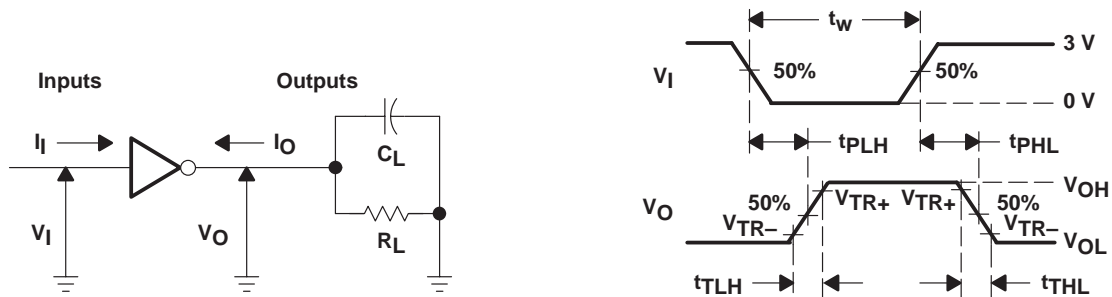
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receiver switching characteristics over operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 4)

PARAMETER		MIN	TYP	MAX	UNIT
t_{PHL}	Propagation delay time, high- to low-level output		400	900	ns
t_{PLH}	Propagation delay time, low- to high-level output		400	900	
t_{TLH}	Transition time, low- to high-level output		200	450	ns
t_{THL}	Transition time, high- to low-level output		200	400	
$t_{sk(p)}$	Pulse skew $ t_{PLH} - t_{PHL} $		200	425	ns

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The pulse generator has the following characteristics:
 For $C_L < 1000$ pF: $t_w = 4$ μ s, PRR = 250 kbit/s, $Z_O = 50$ Ω , $t_r = t_f < 50$ ns.
 For $C_L = 2500$ pF: $t_w = 8$ μ s, PRR = 125 kbit/s, $Z_O = 50$ Ω , $t_r = t_f < 50$ ns.
 B. C_L includes probe and jig capacitance.

Figure 1. Driver Parameter Test Circuit and Waveform

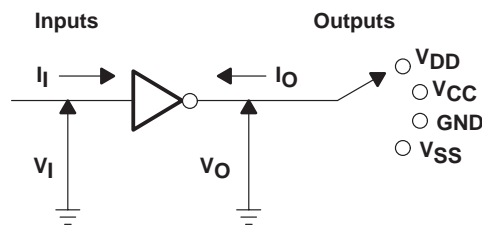


Figure 2. Driver I_{OS} Test

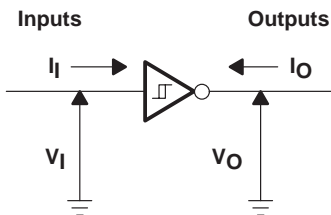
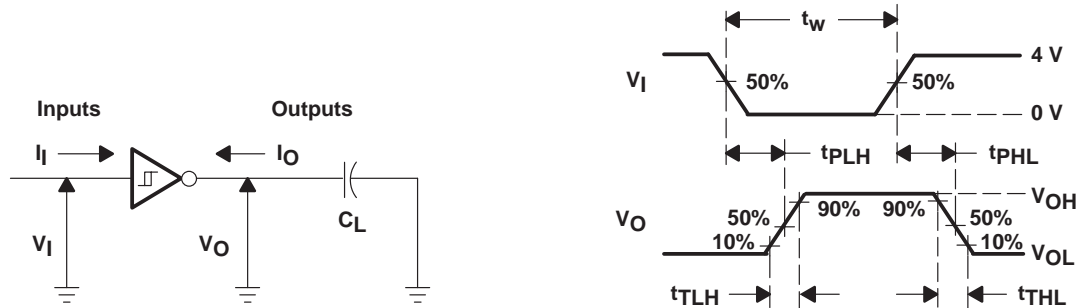


Figure 3. Receiver V_{IT} Test



PARAMETER MEASUREMENT INFORMATION



NOTES: A. The pulse generator has the following characteristics: $t_w = 4 \mu s$, PRR = 250 kbit/s, $Z_o = 50 \Omega$, $t_r = t_f < 50 ns$.
B. C_L includes probe and jig capacitance.

Figure 4. Receiver Parameter Test Circuit and Waveform

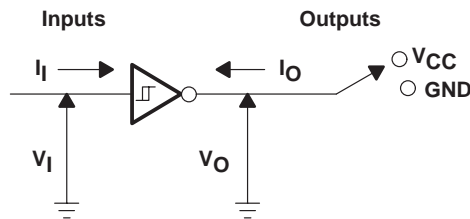


Figure 5. Receiver I_{OS} Test

APPLICATION INFORMATION

Diodes placed in series with the V_{DD} and V_{SS} leads protect the SN75LP196 in the fault condition in which the device outputs are shorted to $\pm 15 V$ and the power supplies are at low voltage and provide low-impedance paths to ground (see Figure 6).

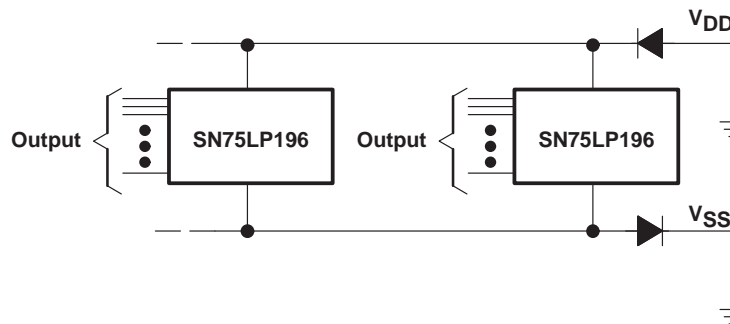


Figure 6. Power-Supply Protection to Meet Power-Off Fault Conditions of EIA/TIA-232-F

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN75LP196DBR	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DBRE4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DBRG4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DWE4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DWRE4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LP196DWRG4	ACTIVE	SOIC	DW	20	2000	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.

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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TAPE AND REEL INFORMATION

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
SN75LP196DBR	SSOP	DB	20	2000	330.0	16.4	8.2	7.5	2.5	12.0	16.0	Q1
SN75LP196DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.0	2.7	12.0	24.0	Q1

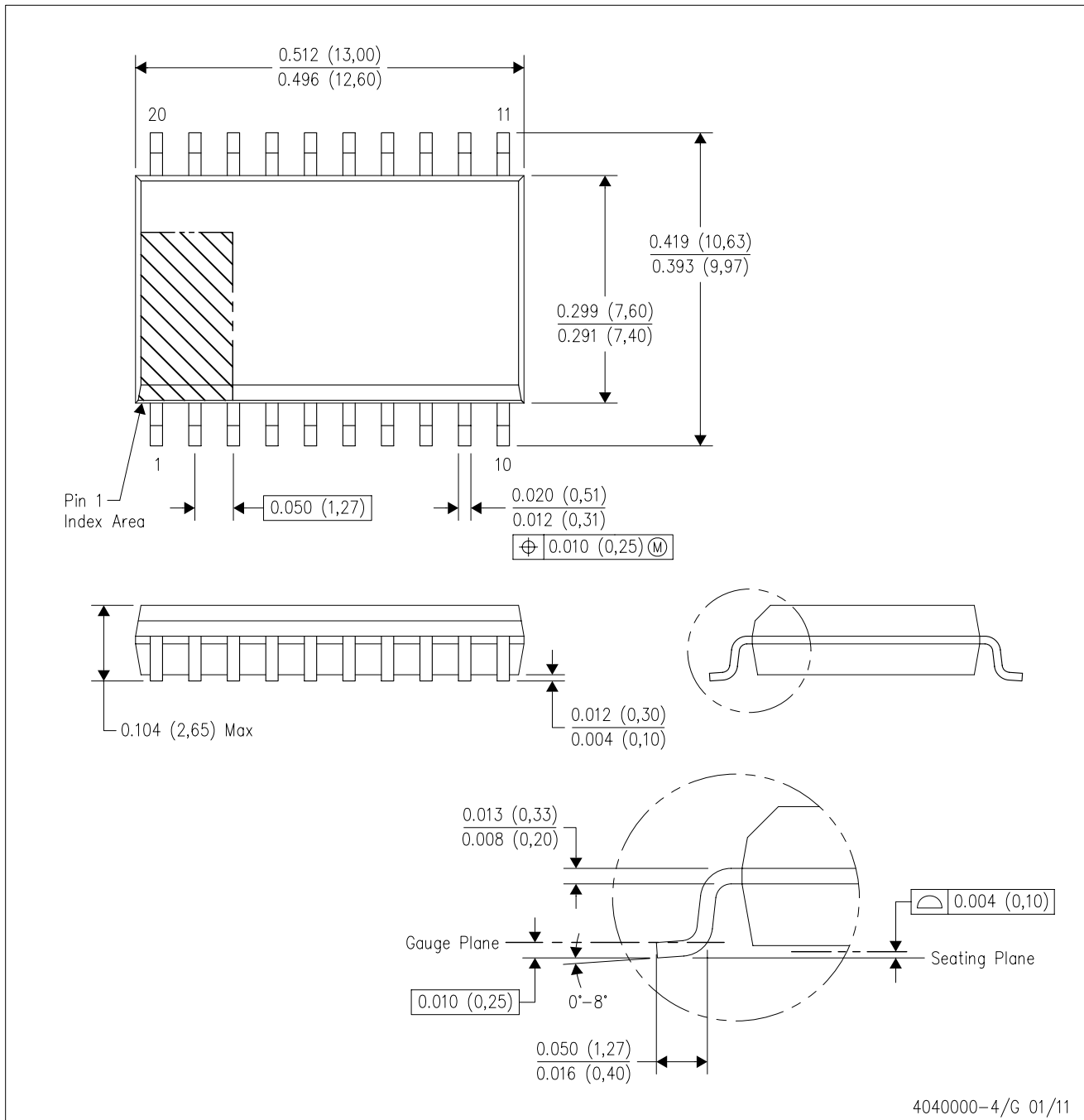
TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75LP196DBR	SSOP	DB	20	2000	346.0	346.0	33.0
SN75LP196DWR	SOIC	DW	20	2000	346.0	346.0	41.0

DW (R-PDSO-G20)

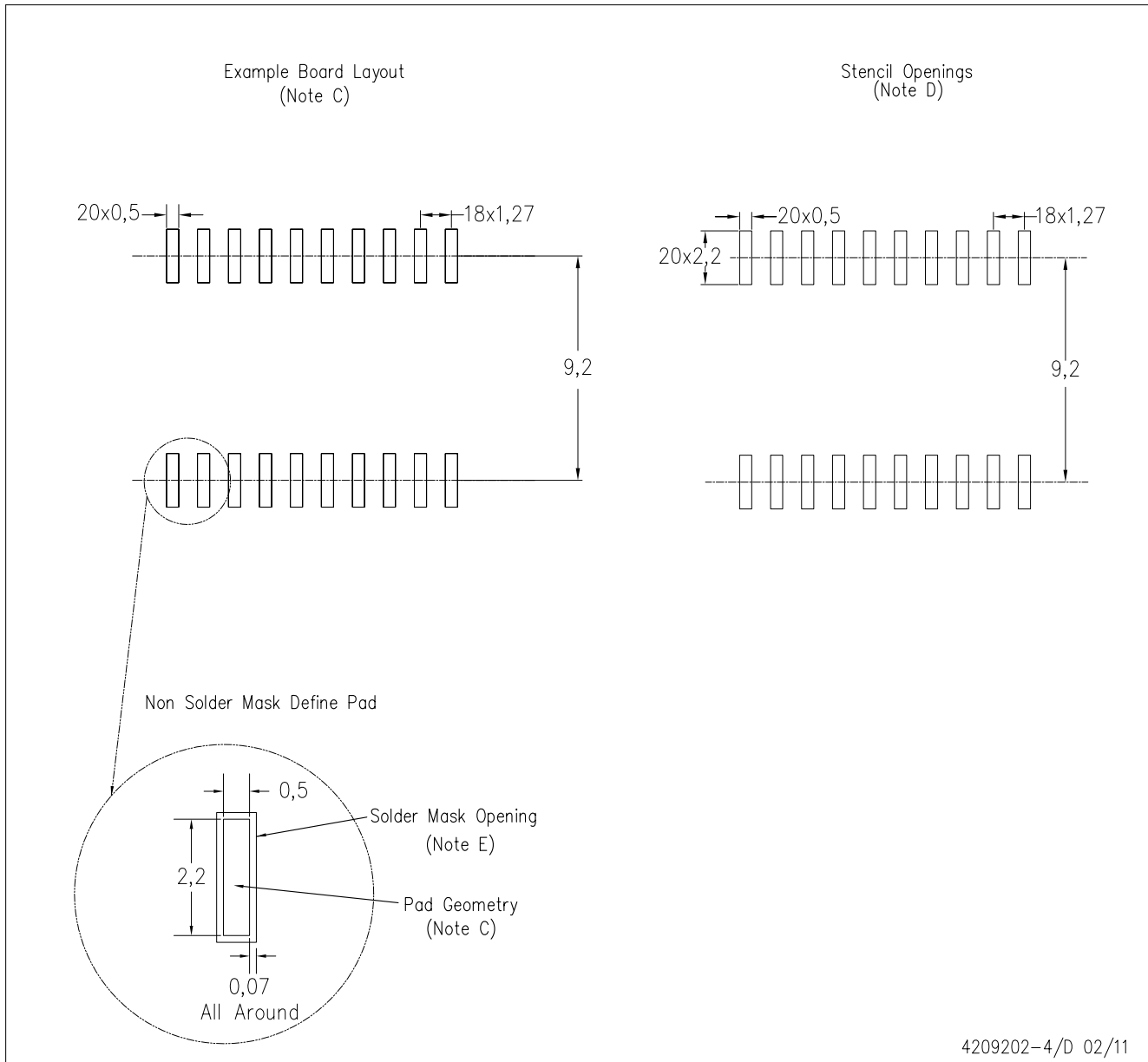
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - 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 MS-013 variation AC.

DW (R-PDSO-G20)

PLASTIC SMALL OUTLINE

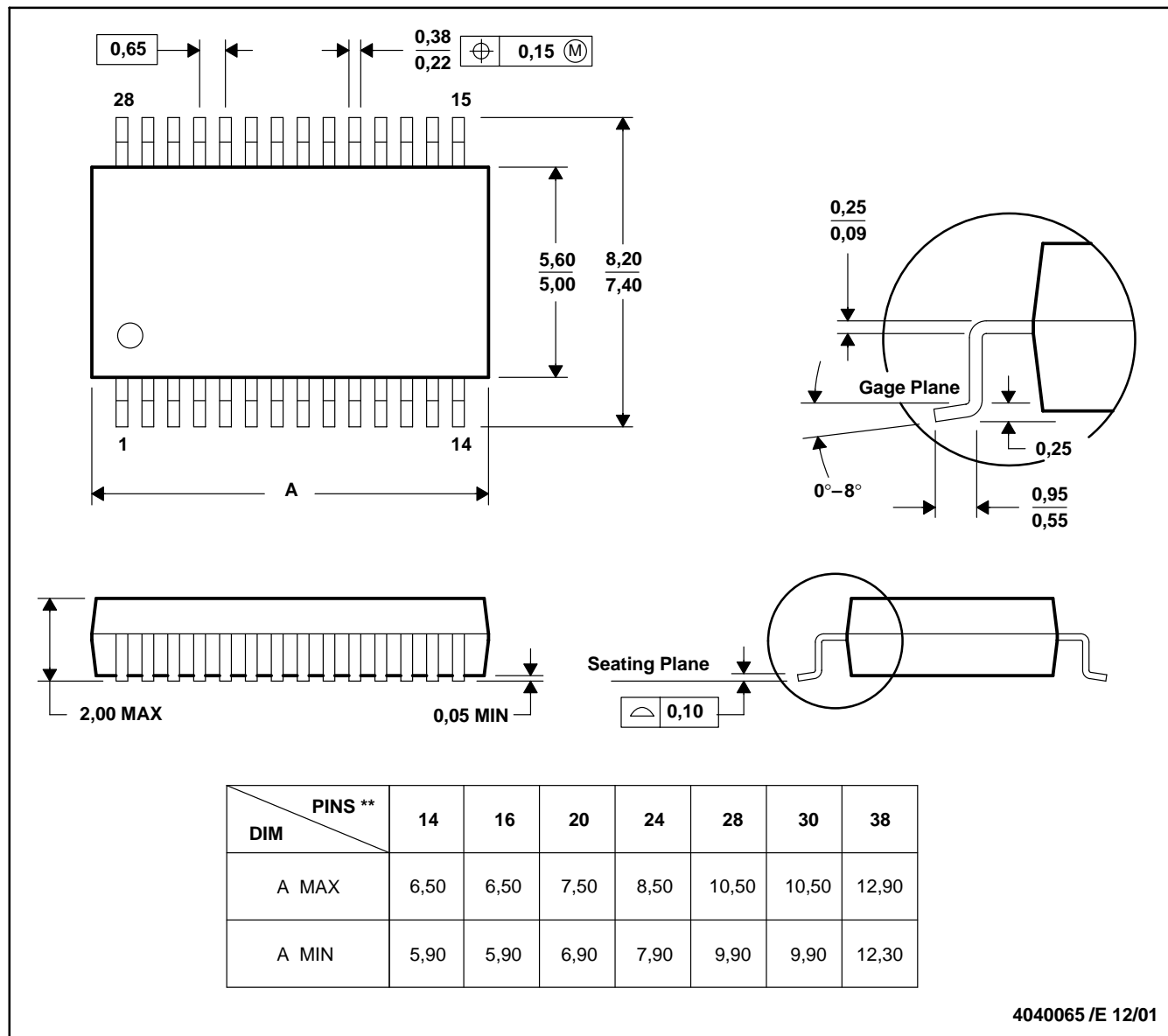


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 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 flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

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