

# SN55113, SN75113 DUAL DIFFERENTIAL LINE DRIVERS

SLLS070C – SEPTEMBER 1973 – REVISED MARCH 1997

- Choice of Open-Collector, Open-Emitter, or 3-State Outputs
- High-Impedance Output State for Party-Line Applications
- Single-Ended or Differential AND/NAND Outputs
- Single 5-V Supply
- Dual Channel Operation
- Compatible With TTL
- Short-Circuit Protection
- High-Current Outputs
- Common and Individual Output Controls
- Clamp Diodes at Inputs and Outputs
- Easily Adaptable to SN55114 and SN75114 Applications
- Designed for Use With SN55115 and SN75115

## description

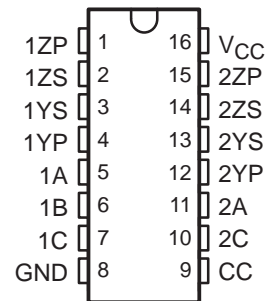
The SN55113 and SN75113 dual differential line drivers with 3-state outputs are designed to provide all the features of the SN55114 and SN75114 line drivers with the added feature of driver output controls. Individual controls are provided for each output pair, as well as a common control for both output pairs. If any output

is low, the associated output is in a high-impedance state and the output can neither drive nor load the bus. This permits many devices to be connected together on the same transmission line for party-line applications.

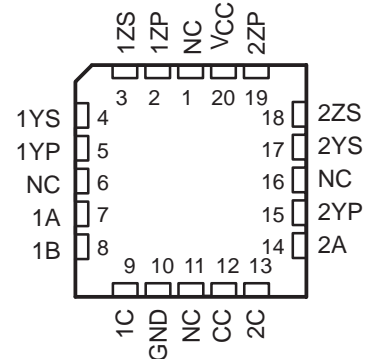
The output stages are similar to TTL totem-pole outputs, but with the sink outputs, YS and ZS, and the corresponding active pullup terminals, YP and ZP, available on adjacent package pins.

The SN55113 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN75113 is characterized for operation over the temperature range of  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN55113 . . . J OR W PACKAGE  
SN75113 . . . N PACKAGE  
(TOP VIEW)



SN55113 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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.

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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FUNCTION TABLE

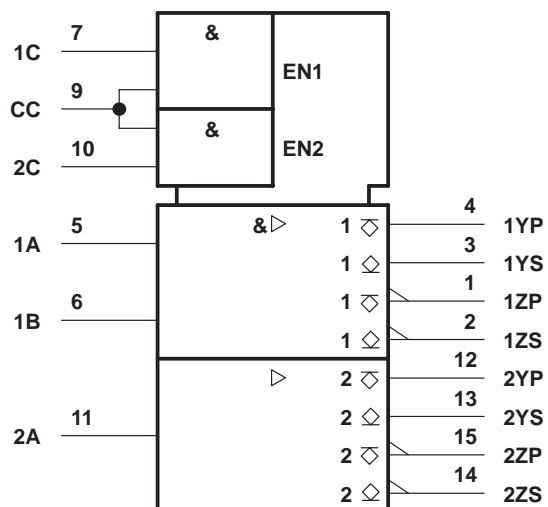
INPUTS		OUTPUTS			
OUTPUT C	CONTROL CC	DATA		AND Y	NAND Z
		A	B†		
L	X	X	X	Z	Z
X	L	X	X	Z	Z
H	H	L	X	L	H
H	H	X	L	L	H
H	H	H	H	H	L

H = high level, L = low level, X = irrelevant,

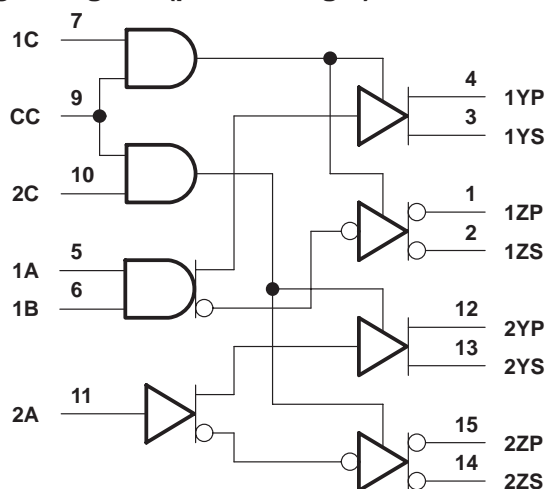
Z = high impedance (off)

† B input and 4th line of function table are applicable only to driver number 1.

## logic symbol†



## logic diagram (positive logic)



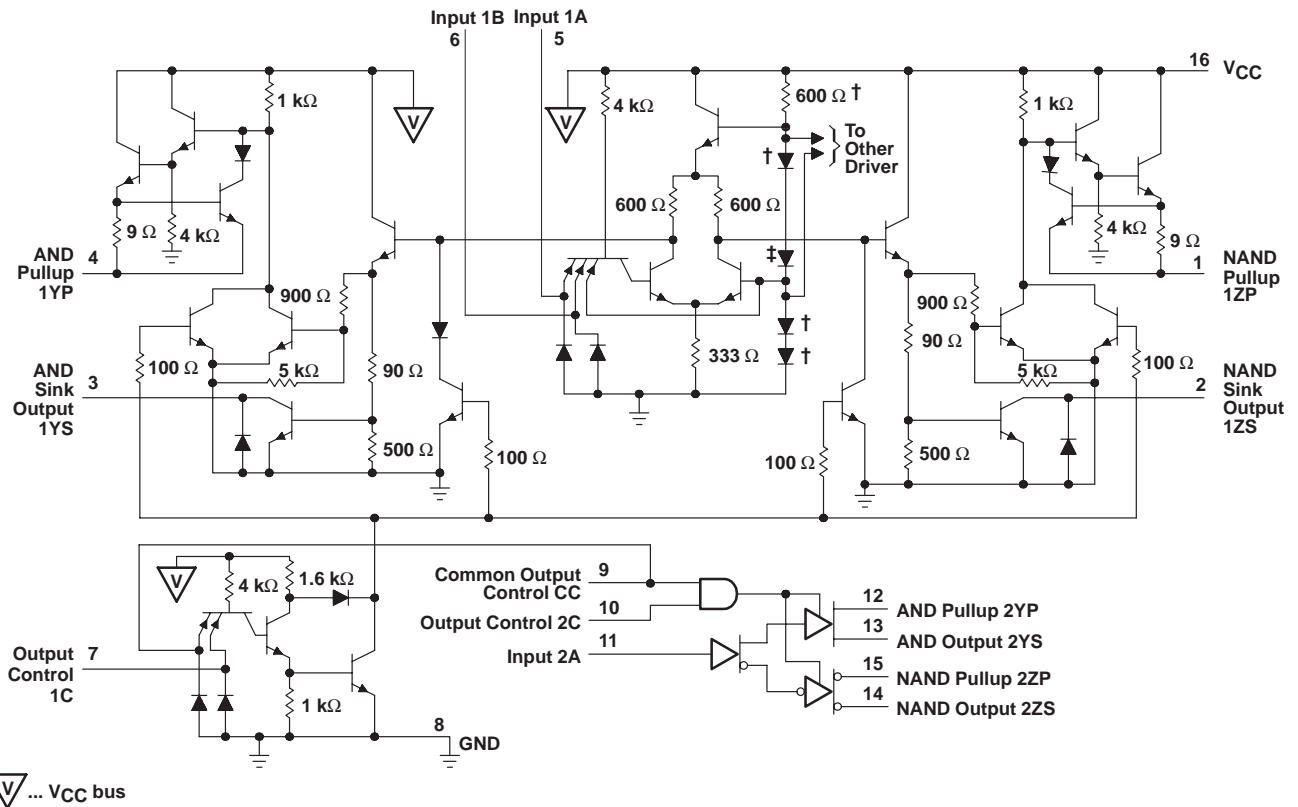
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for the J, N, and W packages.

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## schematic



† These components are common to both drivers. Resistor values shown are nominal and in ohms.

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage, $V_I$	5.5 V
Off-state voltage applied to open-collector outputs	12 V
Continuous total power dissipation (see Note 2)	See Dissipation Rating Table
Operating free-air temperature range, $T_A$ : SN55113	-55°C to 125°C
SN75113	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: N package	260°C
Case temperature for 60 seconds: FK package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J or W package	300°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.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
FK	1375 mW	11.0 mW/°C	880 mW	275 mW
J	1375 mW	11.0 mW/°C	880 mW	275 mW
N	1150 mW	9.2 mW/°C	736 mW	N/A
W	1000 mW	8.0 mW/°C	640 mW	200 mW

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## recommended operating conditions

	SN55113			SN75113			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
High-level input voltage, $V_{IH}$	2			2			V
Low-level input voltage, $V_{IL}$	0.8			0.8			V
High-level output current, $I_{OH}$	-40			-40			mA
Low-level output current, $I_{OL}$	40			40			mA
Operating free-air temperature, $T_A$	-55			125			°C

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

PARAMETER		TEST CONDITIONS†		SN55113			SN75113			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$	Input clamp voltage	$V_{CC} = \text{MIN}$ , $I_I = -12 \text{ mA}$		-0.9	-1.5		-0.9	-1.5	V	
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$ , $V_{IL} = 0.8 \text{ V}$	$V_{IH} = 2 \text{ V}$	$I_{OH} = -10 \text{ mA}$	2.4	3.4	2.4	3.4	V	
				$I_{OH} = -40 \text{ mA}$	2	3.0	2	3.0		
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$ , $I_{OL} = 40 \text{ mA}$	$V_{IH} = 2 \text{ V}$ , $V_{IL} = 0.8 \text{ V}$	0.23	0.4		0.23	0.4	V	
$V_{OK}$	Output clamp voltage	$V_{CC} = \text{MAX}$ , $I_O = -40 \text{ mA}$		-1.1	-1.5		-1.1	-1.5	V	
$I_{O(\text{off})}$	Off-state open-collector output current	$V_{CC} = \text{MAX}$	$V_{OH} = 12 \text{ V}$	$T_A = 25^\circ\text{C}$	1	10			$\mu\text{A}$	
				$T_A = 125^\circ\text{C}$		200				
			$V_{OH} = 5.25 \text{ V}$	$T_A = 25^\circ\text{C}$			1	10		
				$T_A = 70^\circ\text{C}$				20		
$I_{OZ}$	Off-state (high-impedance-state) output current	$V_{CC} = \text{MAX}$ , Output controls at $0.8 \text{ V}$	$T_A = \text{MAX}$	$T_A = 25^\circ\text{C}$ , $V_O = 0 \text{ to } V_{CC}$		$\pm 10$		$\pm 10$	$\mu\text{A}$	
				$V_O = 0$		-150		-20		
				$V_O = 0.4 \text{ V}$		$\pm 80$		$\pm 20$		
				$V_O = 2.4 \text{ V}$		$\pm 80$		$\pm 20$		
				$V_O = V_{CC}$		80		20		
$I_I$	Input current at maximum input voltage	A, B, C	$V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$		1		1	mA		
		CC			2		2			
$I_{IH}$	High-level input current	A, B, C	$V_{CC} = \text{MAX}$ , $V_I = 2.4 \text{ V}$		40		40	$\mu\text{A}$		
		CC			80		80			
$I_{IL}$	Low-level input current	A, B, C	$V_{CC} = \text{MAX}$ , $V_I = 0.4 \text{ V}$		-1.6		-1.6	mA		
		CC			-3.2		-3.2			
$I_{OS}$	Short-circuit output current§	$V_{CC} = \text{MAX}$ , $V_O = 0$ , $T_A = 25^\circ\text{C}$		-40	-90	-120	-40	-90	-120	mA
$I_{CC}$	Supply current (both drivers)	All inputs at $0 \text{ V}$ , No load, $T_A = 25^\circ\text{C}$		$V_{CC} = \text{MAX}$	47	65	47	65	mA	
				$V_{CC} = 7 \text{ V}$	65	85	65	85		

† All parameters with the exception of off-state open-collector output current are measured with the active pullup connected to the sink output. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 5 \text{ V}$ , with the exception of  $V_{CC}$  at  $7 \text{ V}$ .

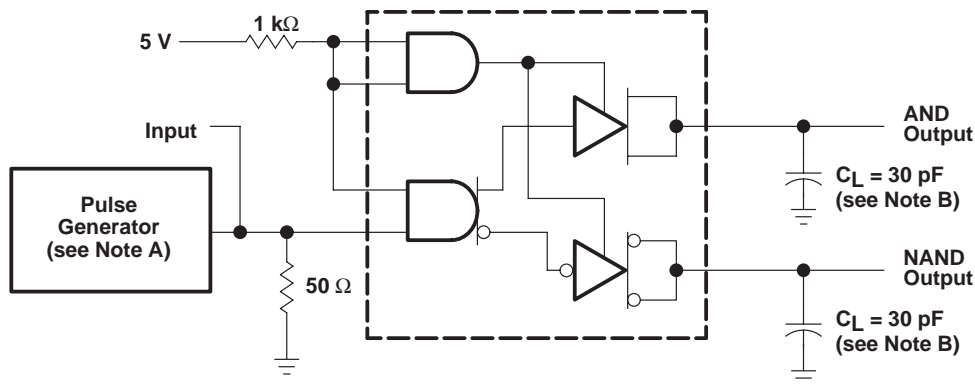
§ Only one output should be shorted at a time, and duration of the short-circuit should not exceed one second.



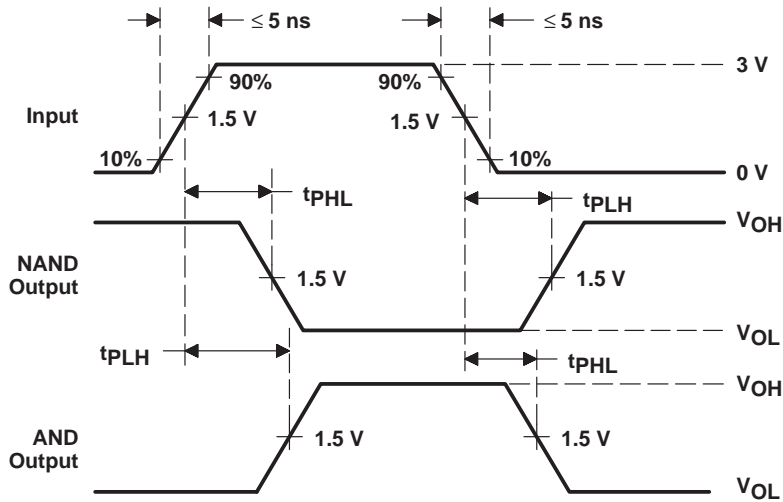
switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $C_L = 30\text{ pF}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	SN55113			SN75113			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$t_{PLH}$ Propagation delay time, low-to-high level output	See Figure 1		13	20		13	30	ns
$t_{PHL}$ Propagation delay time, high-to-low-level output			12	20		12	30	ns
$t_{PZH}$ Output enable time to high level	$R_L = 180\ \Omega$ , See Figure 2		7	15		7	20	ns
$t_{PZL}$ Output enable time to low level	$R_L = 250\ \Omega$ , See Figure 3		14	30		14	40	ns
$t_{PHZ}$ Output disable time from high level	$R_L = 180\ \Omega$ , See Figure 2		10	20		10	30	ns
$t_{PLZ}$ Output disable time from low level	$R_L = 250\ \Omega$ , See Figure 3		17	35		17	35	ns

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

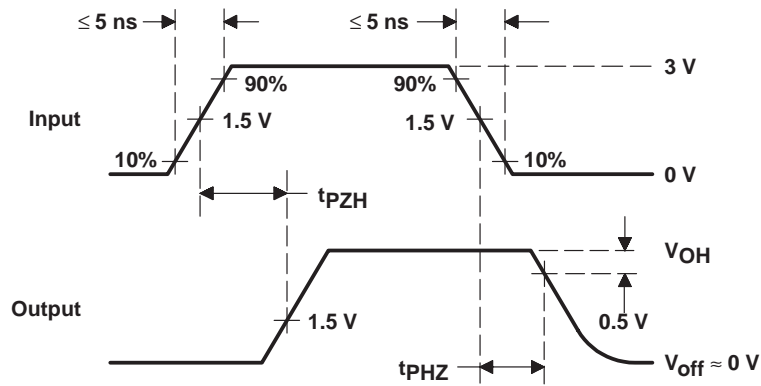
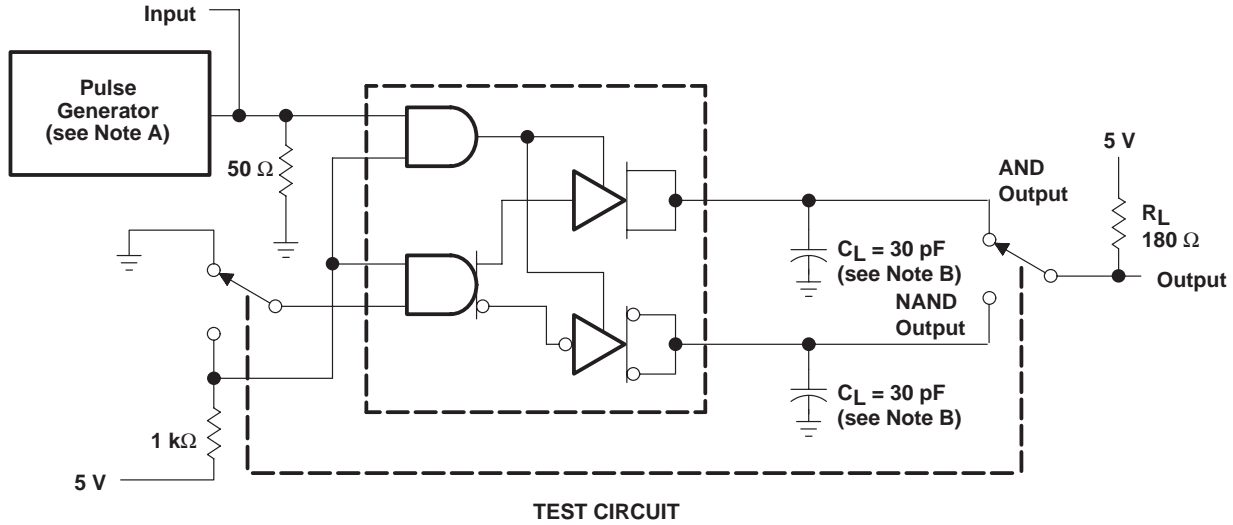
- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50\ \Omega$ ,  $PRR \leq 500\text{ kHz}$ ,  $t_w = 100\text{ ns}$ .  
B.  $C_L$  includes probe and jig capacitance.

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

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## PARAMETER MEASUREMENT INFORMATION

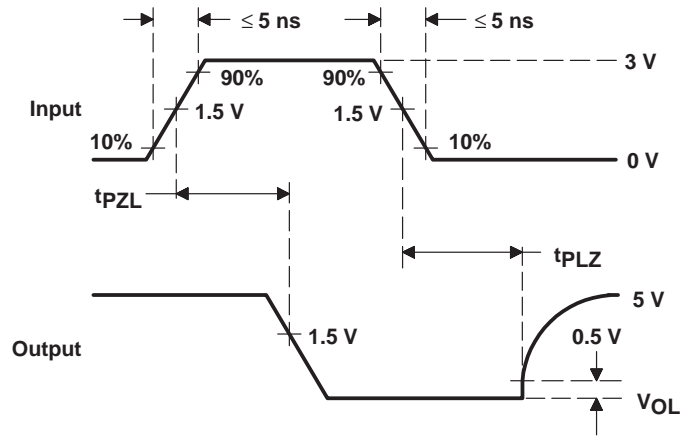
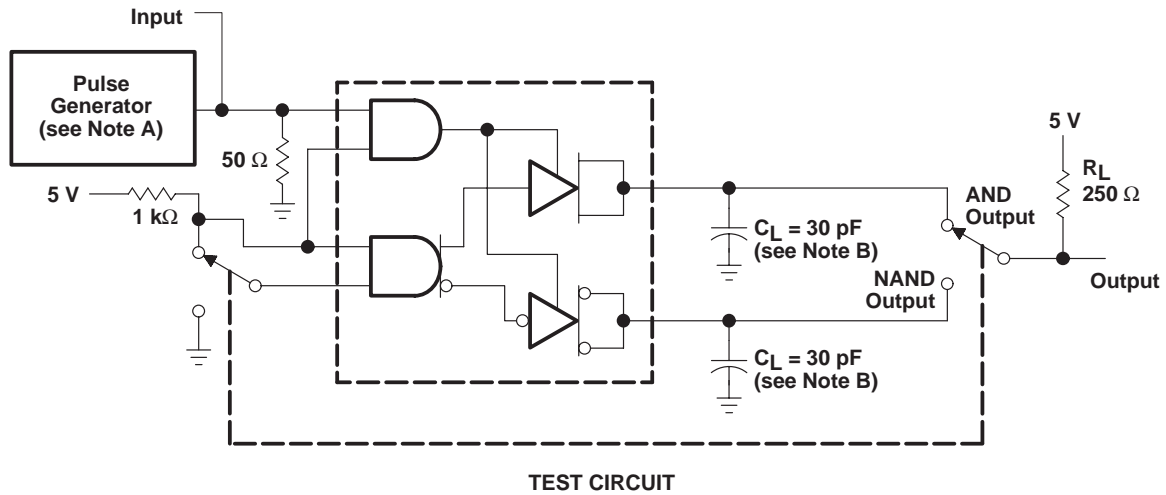


VOLTAGE WAVEFORMS

- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50\ \Omega$ ,  $PRR \leq 500\text{ kHz}$ ,  $t_w = 100\text{ ns}$ .  
B.  $C_L$  includes probe and jig capacitance.

Figure 2. Test Circuit and Voltage Waveforms  $t_{pZH}$  and  $t_{pHZ}$

PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS

- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ ,  $PRR \leq 500 \text{ kHz}$ ,  $t_W = 100 \text{ ns}$ .  
 B.  $C_L$  includes probe and jig capacitance.

Figure 3. Test Circuit and Voltage Waveforms,  $t_{pZL}$  and  $t_{pLZ}$

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## TYPICAL CHARACTERISTICS†

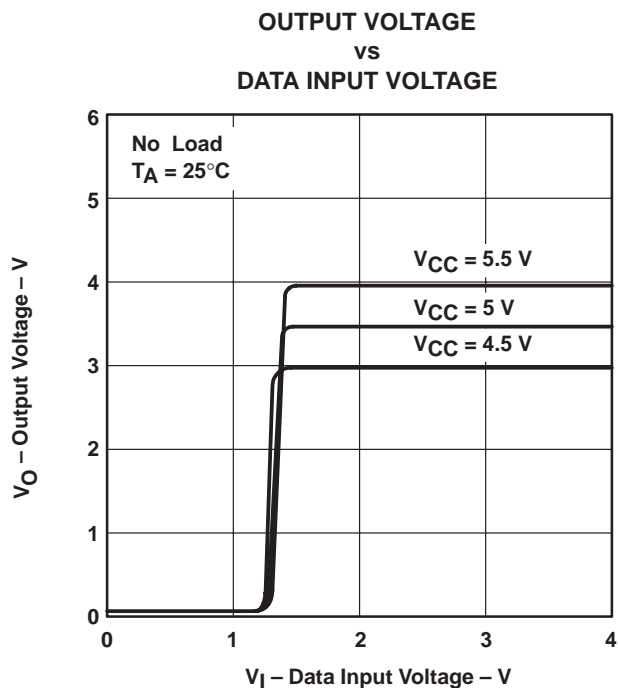


Figure 4

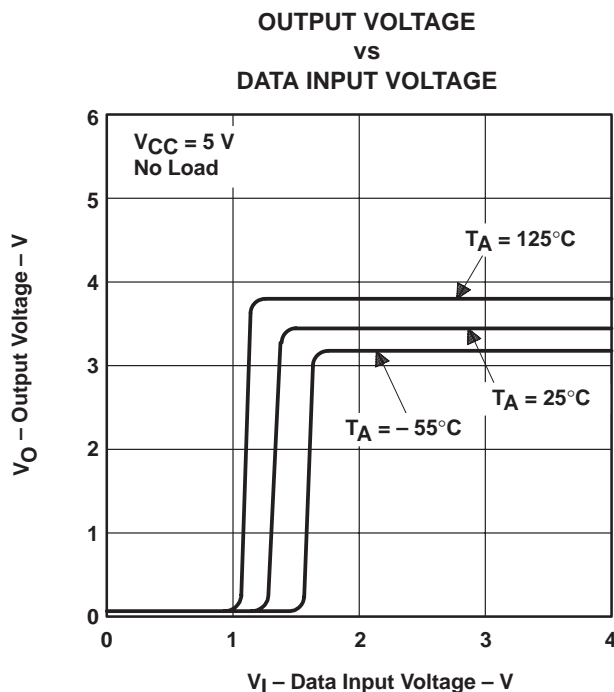


Figure 5

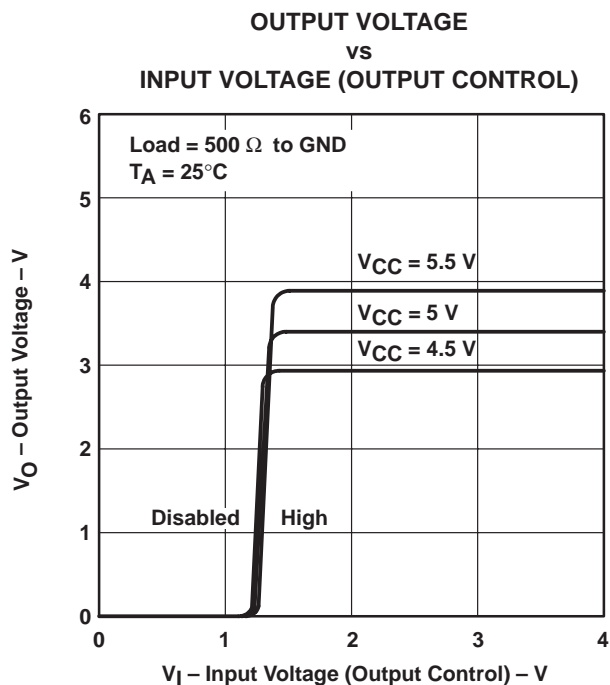


Figure 6

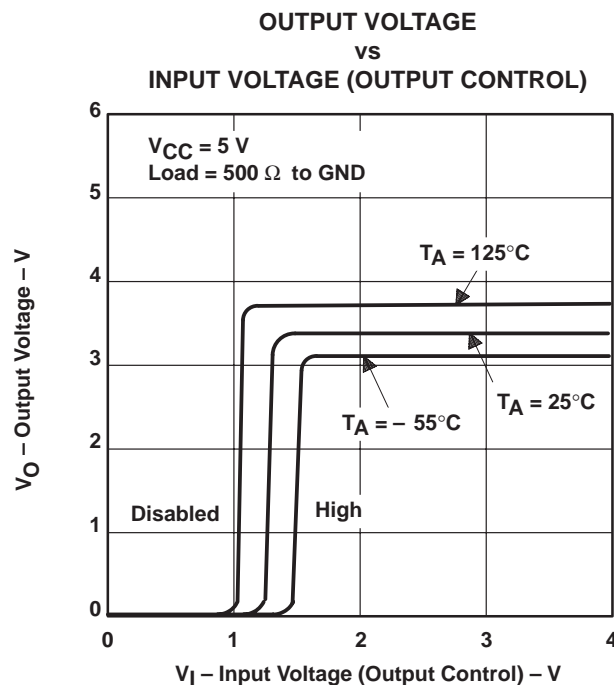


Figure 7

† Data for temperatures below  $0^\circ\text{C}$  and above  $70^\circ\text{C}$  and for supply voltages below  $4.75\text{ V}$  and above  $5.25\text{ V}$  are applicable to SN55113 circuits only. These parameters were measured with the active pullup connected to the sink output.



TYPICAL CHARACTERISTICS†

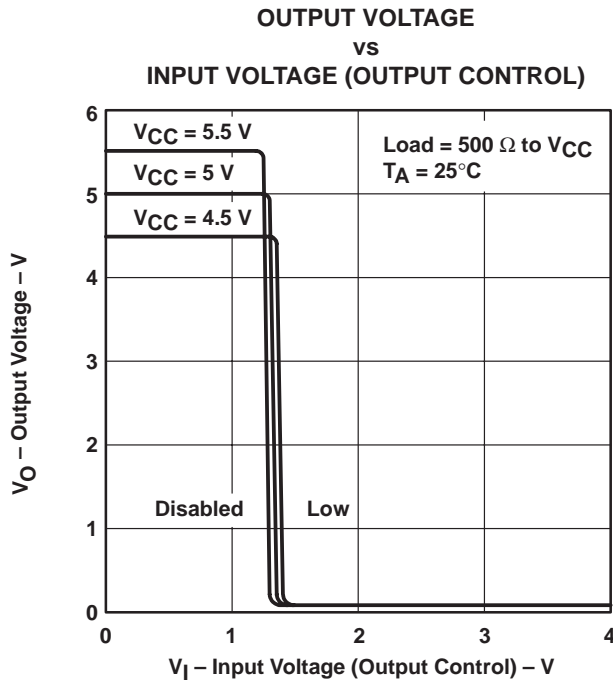


Figure 8

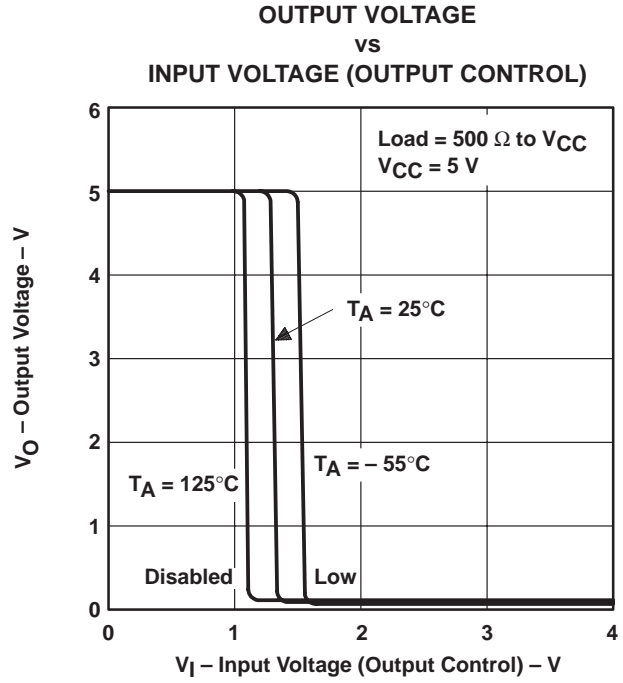


Figure 9

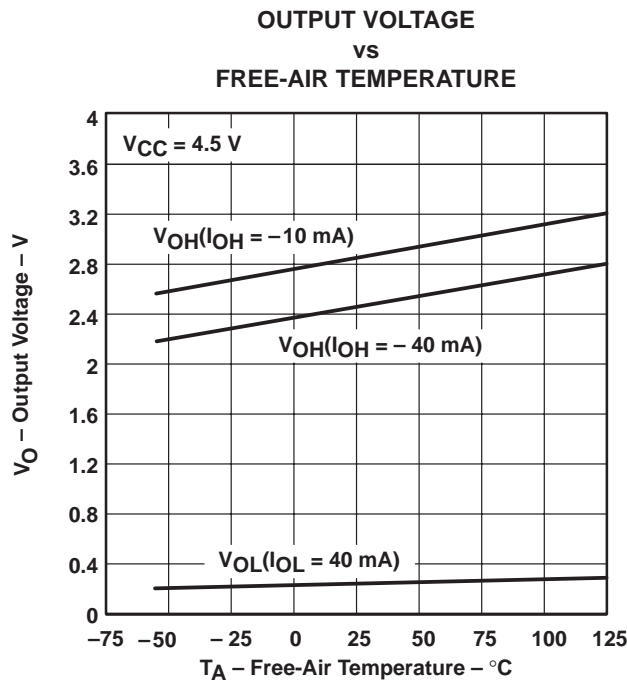


Figure 10

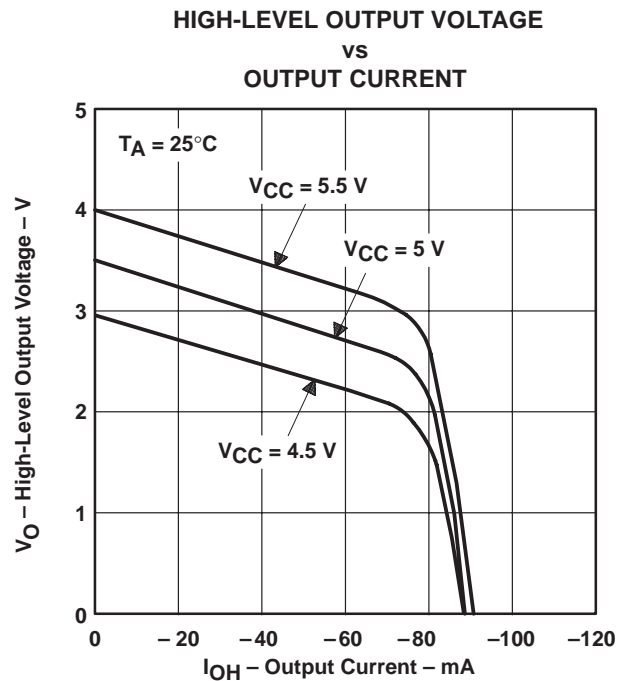


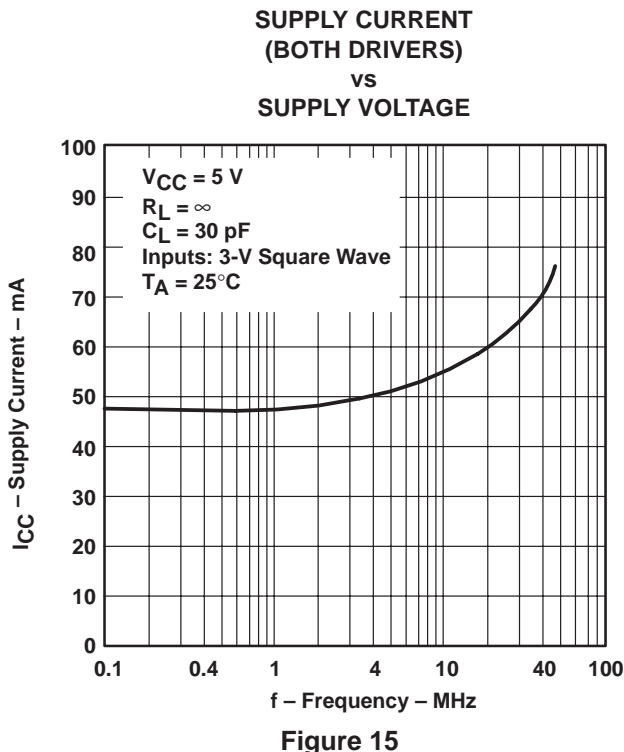
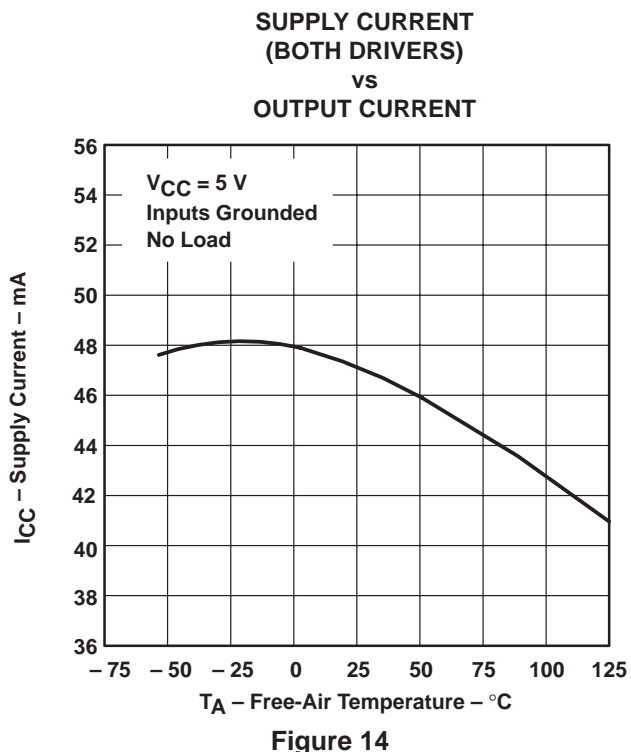
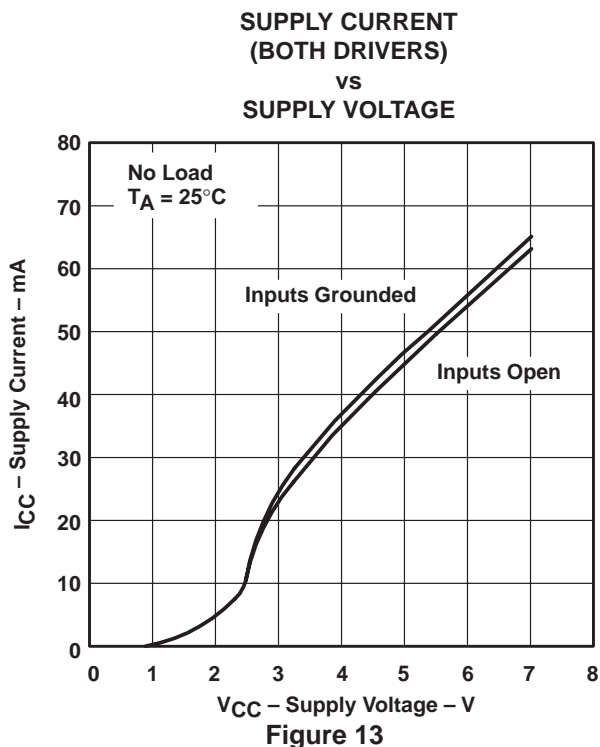
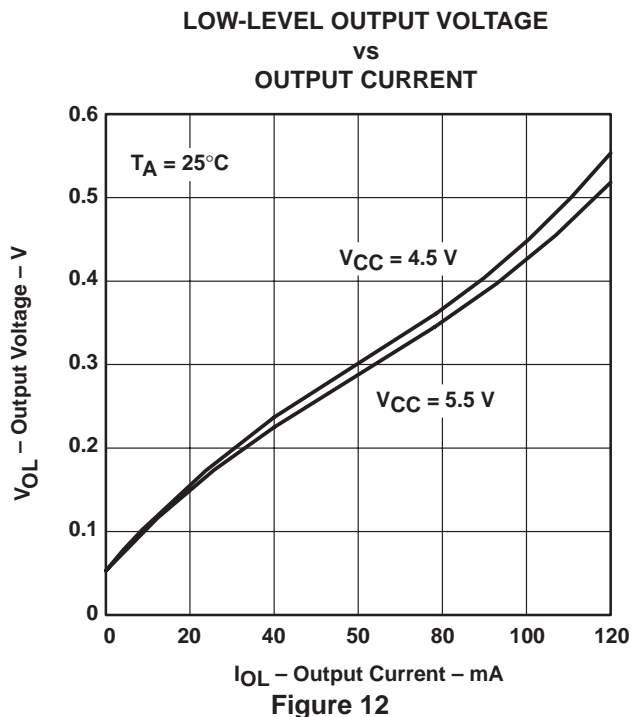
Figure 11

† Data for temperatures below 0°C and above 70°C and for supply voltages below 4.75 V and above 5.25 V are applicable to SN55113 circuits only. These parameters were measured with the active pullup connected to the sink output.

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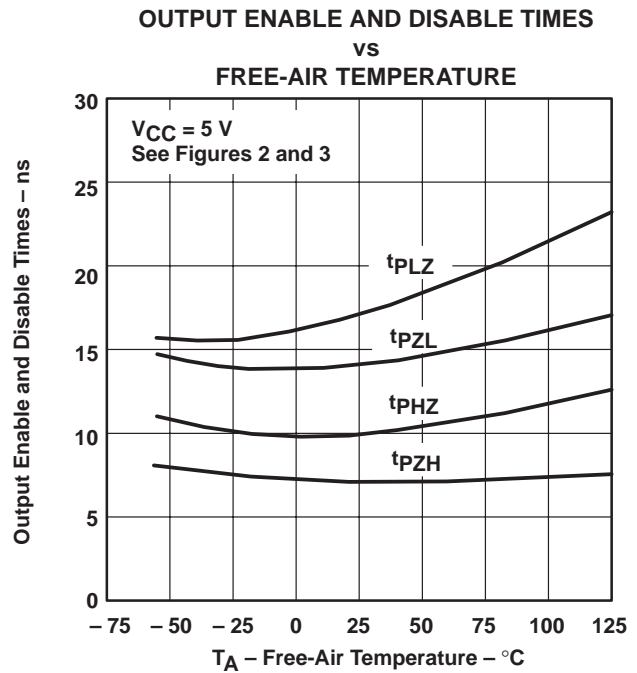
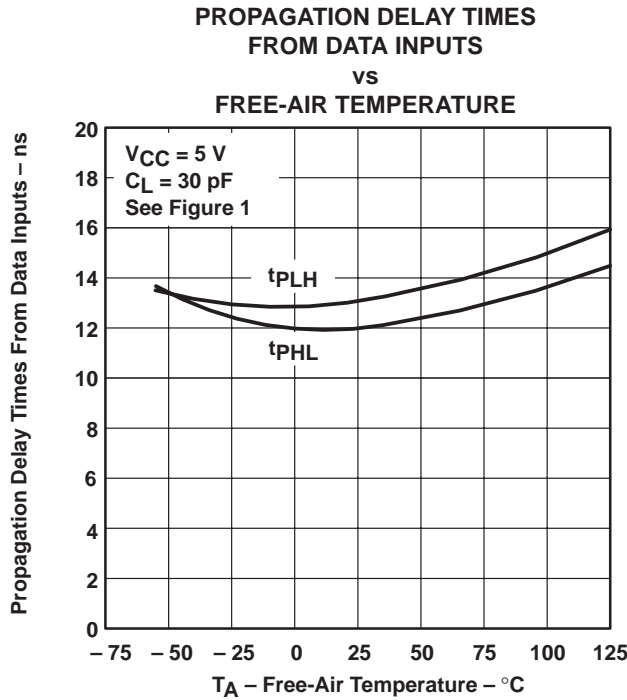
## TYPICAL CHARACTERISTICS†



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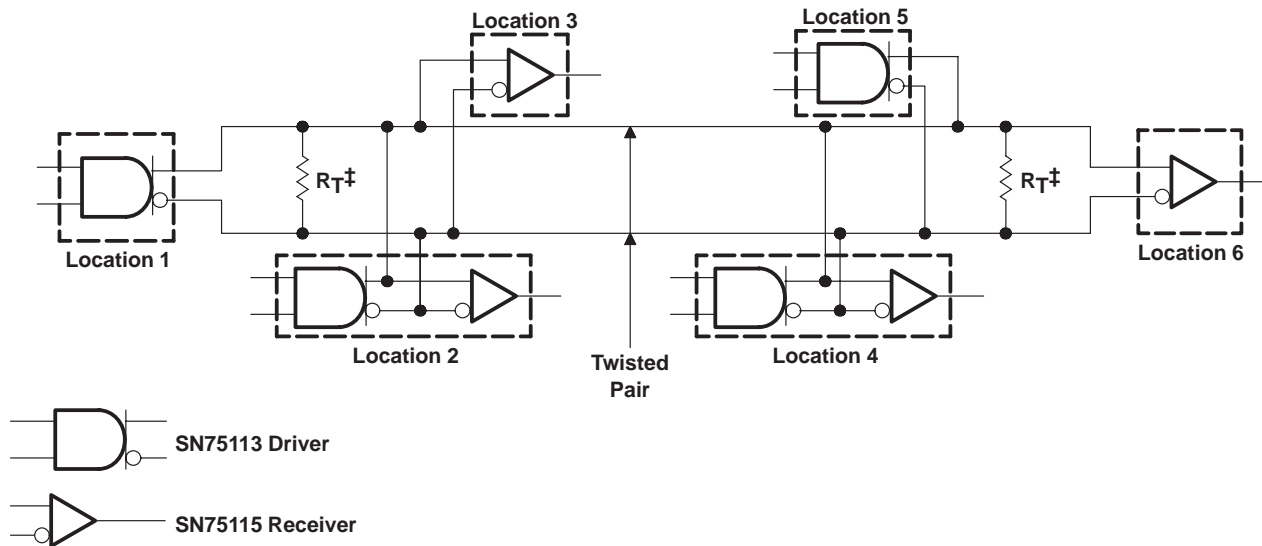


TYPICAL CHARACTERISTICS†



† Data for temperatures below 0°C and above 70°C and for supply voltages below 4.75 V and above 5.25 V are applicable to SN55113 circuits only. These parameters were measured with the active pullup connected to the sink output.

APPLICATION INFORMATION



†  $R_T = Z_O$ . A capacitor may be connected in series with  $R_T$  to reduce power dissipation.

Figure 18. Basic Party-Line or Data-Bus Differential Data Transmission

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-88744012A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-8874401EA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
5962-8874401FA	ACTIVE	CFP	W	16	1	TBD	A42 SNPB	N / A for Pkg Type
JM38510/10405BEA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN55113J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN75113D	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN75113DR	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN75113N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75113NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75113NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75113NSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75113NSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ55113FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ55113J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ55113W	ACTIVE	CFP	W	16	1	TBD	A42 SNPB	N / A for Pkg Type

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

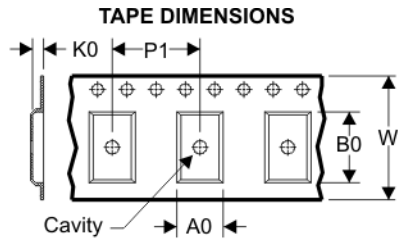
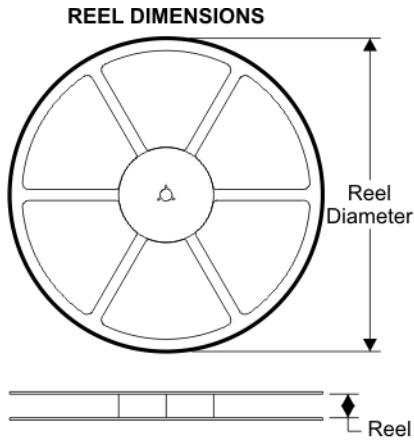
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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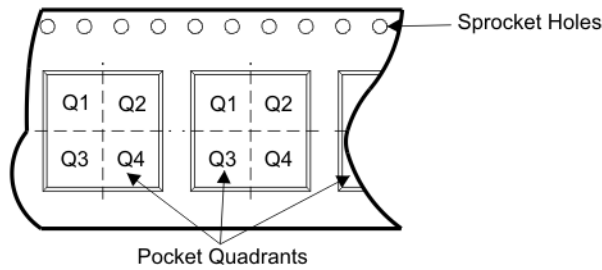
to Customer on an annual basis.

**TAPE AND REEL BOX INFORMATION**



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**



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN75113NSR	NS	16	SITE 41	330	16	8.2	10.5	2.5	12	16	Q1

**TAPE AND REEL BOX DIMENSIONS**



Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
SN75113NSR	NS	16	SITE 41	346.0	346.0	33.0

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



4040180-3/D 07/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



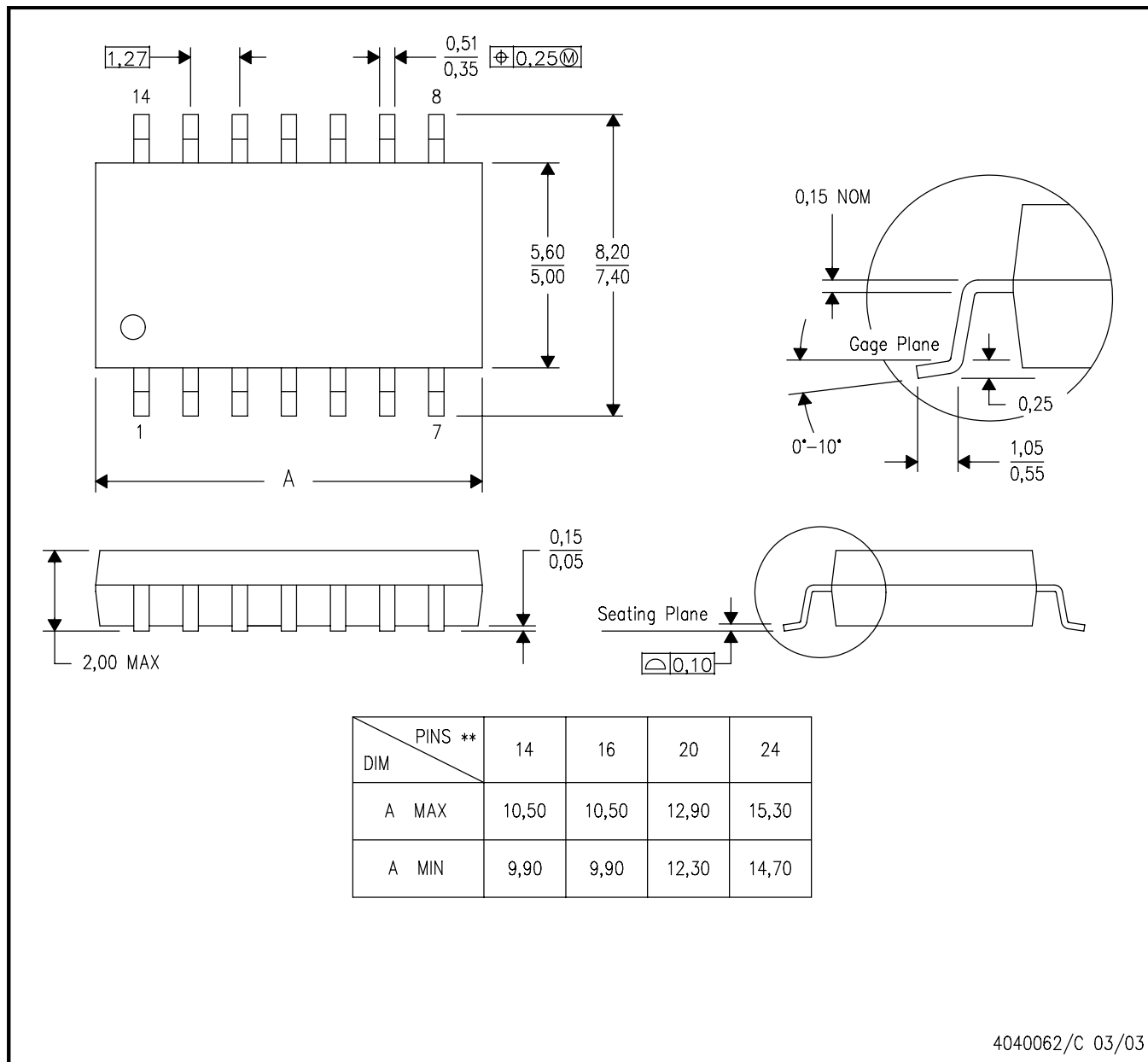
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AC.

## MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-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.

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