

SN55116, SN75116 THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

SLLS073A - D2143, MAY 1976 - REVISED FEBRUARY 1993

features common to all types

- Single 5-V Supply
- 3-State Driver Output Circuitry
- TTL-Compatible Driver Inputs
- TTL-Compatible Receiver Output
- Differential Line Operation
- Receiver Output Strobe ('116, SN75117) or Enable (SN75118, SN75119)
- Designed for Party-Line (Data-Bus) Applications
- Choice of Ceramic or Plastic Packages

additional features of the SN55116/SN75116

- Independent Driver and Receiver
- Choice of Open-Collector or Totem-Pole Outputs on Both Driver and Receiver
- Dual Data inputs on Driver
- Optional Line-Termination Resistor in Receiver
- ± 15 -V Receiver Common-Mode Capability
- Receiver Frequency Response Control

additional features of the SN75117

- Driver Output Internally Connected to Receiver Input

The SN75118 is an SN75116 With 3-State Receiver Output Circuitry

The SN75119 is an SN75117 With 3-State Receiver Output Circuitry

description

These integrated circuits are designed for use in interfacing between TTL-type digital systems and differential data transmission lines. They are especially useful for party-line (data-bus) applications. Each of these circuit types combine in one package a 3-state differential line driver and a differential-input line receiver, both of which operate from a single 5-V power supply. The driver inputs and receiver outputs are TTL compatible. The driver employed is similar to the SN55113/SN75113 3-state line driver, and the receiver is similar to the SN55115/SN75115 line receiver.

The '116 and SN75118 circuits offer all the features of the SN55113/SN75113 driver and the SN55115/SN75115 receiver combined. The driver performs the dual input AND and NAND functions when enabled or presents a high impedance to the load when in the disabled state. The driver output stages are similar to TTL totem-pole outputs, but have the current-sink portion separated from the current-sourcing portion and both are brought out to adjacent package pins. This feature allows the user the option of using the driver in the open-collector output configuration, or, by connecting the adjacent source and sink pins together, of using the driver in the normal totem-pole output configuration.

The receiver portion of the '116 and SN75118 features a differential-input circuit having a common-mode voltage range of ± 15 V. An internal 130- Ω resistor is also provided, which may optionally be used for terminating the transmission line. A frequency response control pin allows the user to reduce the speed of the receiver or to improve differential noise immunity. The receiver of the '116 also has an output strobe and a split totem-pole output. The receiver of the SN75118 has an output-enable for the 3-state split totem-pole output. The receiver section of either circuit is independent of the driver section except for the V_{CC} and ground pins.

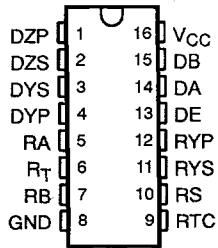
The SN75117 and SN75119 circuits provide the basic driver and receiver functions of the '116 and SN75118, but use a package that is only half as large. The SN75117 and SN75119 are intended primarily for party-line or bus-organized systems as the driver outputs are internally connected to the receiver inputs. The driver has a single data input and a single enable input, and the SN75117 receiver has an output strobe while the SN75119 receiver has a 3-state-output enable. These devices do not, however, provide output connection options, line termination resistors, or receiver frequency-response controls.

The SN55116 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN75116, SN75117, SN75118, and SN75119 are characterized for operation from 0°C to 70°C .

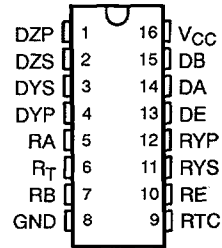
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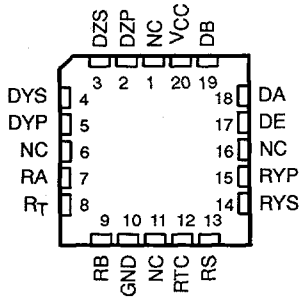
**SN55116 . . . J PACKAGE
SN75116 . . . D OR N PACKAGE
(TOP VIEW)**



**SN75118 . . . D OR N PACKAGE
(TOP VIEW)**

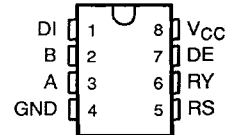


**SN55116 . . . FK PACKAGE
(TOP VIEW)**

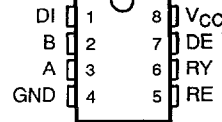


NC - No internal connection

**SN75117 . . . D OR P PACKAGE
(TOP VIEW)**



**SN75119 . . . D OR P PACKAGE
(TOP VIEW)**



Function Tables

**'116, SN75118
DRIVER**

INPUTS			OUTPUTS	
DE	DA	DB	DY	DZ
L	X	X	Z	Z
H	L	X	L	H
H	X	L	L	H
H	H	H	H	L

**SN75117, SN75119
DRIVER**

INPUTS		OUTPUTS	
DI	DE	A	B
H	H	H	L
L	H	L	H
X	L	Z	Z

**'116, SN75118
RECEIVER**

RS/RE	DIFF INPUT	OUTPUTS RY	
		'116	SN75118
L	X	H	Z
H	L	H	H
H	H	L	L

**SN75117, SN75119
RECEIVER**

INPUTS			OUTPUT RY	
A	B	RS/RE	SN75117	SN75119
H	L	H	H	H
L	H	H	L	L
X	X	L	H	Z

H = high level ($V_I \geq V_{IH}$ min or V_{ID} more positive than V_{TH} max)

L = low level ($V_I \leq V_{IL}$ max or V_{ID} more negative than V_{TL} max)

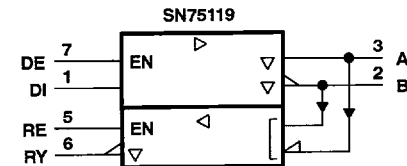
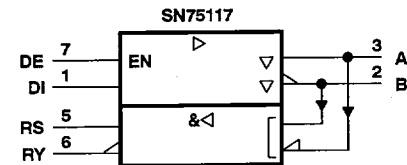
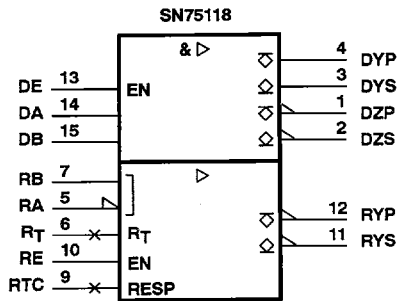
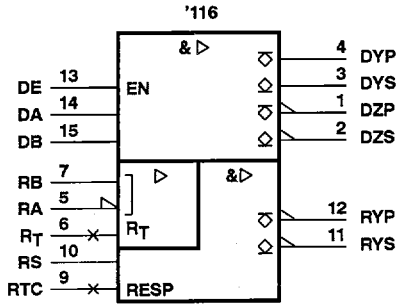
X = irrelevant

Z = high impedance (off)

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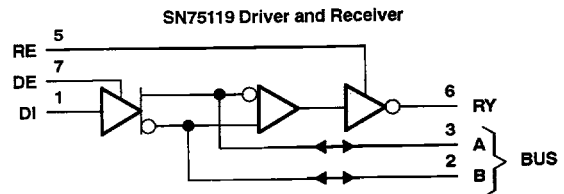
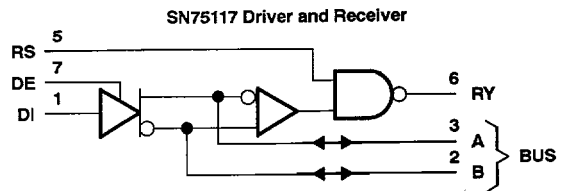
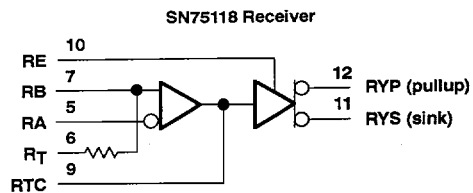
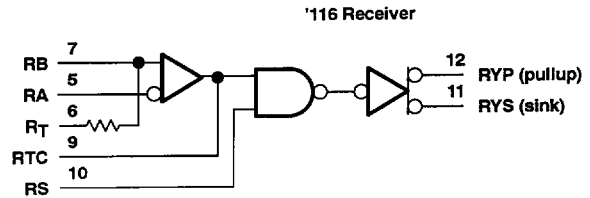
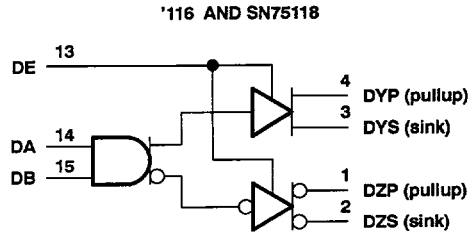
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logic symbols†



† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagrams (positive logic)

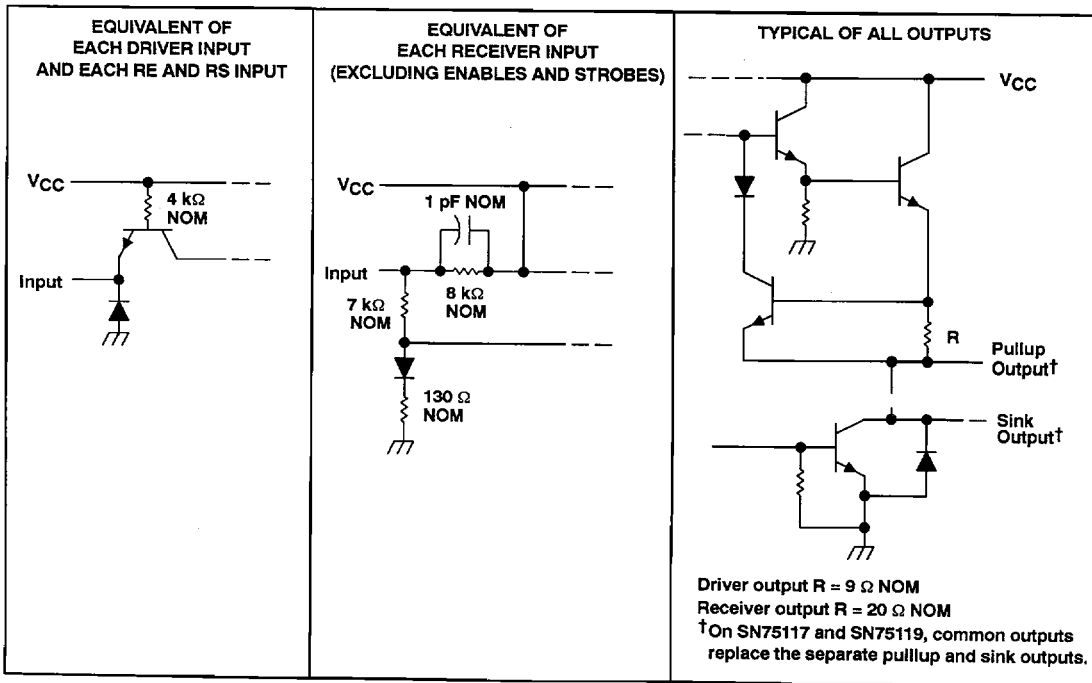


Pin numbers shown for the SN55116 are for the J package, those shown for the SN75118 are for the N package, those shown for SN75117 and SN75119 are for the P package.

SN55116, SN75116 THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

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schematics of inputs and outputs



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

	*116, SN75118	SN75117, SN75119	UNIT
Supply voltage, V_{CC} (see Note 1)	7	7	V
Input voltage, V_I	DA, DB, DE, DI, RE, RS	5.5	V
	RA, RB, RT	± 25	
	A and B	0 to 6	
Off-state voltage applied to open-collector outputs	12		V

	SN55116	SN75116 THRU SN75119	UNIT
Continuous total power dissipation (see Note 2)	See Dissipation Rating Table		
Operating free-air temperature range	-55 to 125	0 to 70	°C
Storage temperature range	-65 to 50	-65 to 50	°C
Case temperature for 60 seconds: FK package	260		°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J package	300	300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, N, or P package		260	°C

NOTES: 1. All voltage values are with respect to network ground terminal.

2. In the FK and J packages, SN55116 chip is alloy mounted and SN75116 through SN75119 chips are glass mounted.

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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
D (8 pin)	725 mW	5.8 mW/°C	464 mW	—
D (16 pin)	950 mW	7.6 mW/°C	608 mW	—
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	—
P	1000 mW	8.0 mW/°C	640 mW	—

recommended operating conditions

PARAMETER		SN55116			SN75'			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.5	5	5.5	V
High-level input voltage, V_{IH}	All inputs except differential inputs	2			2			V
Low-level input voltage, V_{IL}		0.8			0.8			V
High-level output current, I_{OH}	Drivers	-40			-40			mA
	Receivers	-5			-5			
Low-level output current, I_{OL}	Drivers	40			40			mA
	Receivers	15			15			
Receiver input voltage, V_I	'116, '118	±15			±15			V
	'117, '119	0	6	0	6	0	6	
Common-mode receiver input voltage, V_{ICR}	'116, '118	±15			±15			V
	'117, '119	0	6	0	6	0	6	
Operating free-air temperature, T_A		-55	125	0	70	°C		

SN55116, SN75116, THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

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

PARAMETER	TEST CONDITIONS†		'116, SN75118		SN75117, SN75119		UNIT
	VCC = MIN, VIL = 0.8 V, VIH = 2 V	I _I = -12 mA TA = 25°C (SN55116) TA = 0°C to 70°C (SN75) TA = -55°C to 125°C (SN55)	MIN	TYP‡	MIN	TYP‡	
V _{IK} Input clamp voltage	VCC = MIN, VIL = 0.8 V, VIH = 2 V	I _I = -12 mA TA = 25°C (SN55116) TA = 0°C to 70°C (SN75) TA = -55°C to 125°C (SN55)	2.4	3.4	-0.9	-1.5	V
V _{OH} High-level output voltage	VCC = MIN, VIL = 0.8 V, VIH = 2 V	I _{OH} = -10 mA I _{OH} = -40 mA I _{OH} = -10 mA I _{OH} = -40 mA	2	3	2	3	V
V _{OL} Low-level output voltage	VCC = MIN, VIL = 0.8 V, VIH = 2 V	I _{OL} = 40 mA I _{OL} = 40 mA	1.8		1.8		V
V _{OK} Output clamp voltage	VCC = MAX, VIL = 0.8 V, VIH = 2 V	DE at 0.8 V TA = 25°C					V
I _{O(off)} Off-state open-collector output current	VCC = MAX, V _O = 12 V	TA = MAX					μA
I _{OZ} Off-state (high-impedance-state) output current	VCC = MAX, V _O = 12 V	TA = MAX					μA
I _I Input current at maximum input voltage	VCC = MAX, V _O = 12 V	TA = MAX					μA
I _{IH} High-level input current	VCC = MAX, V _O = 12 V	TA = MAX					μA
I _{IL} Low-level input current	VCC = MAX, V _O = 12 V	TA = MAX					μA
I _{OS} Short-circuit output current§	VCC = MAX, V _O = 12 V	TA = MAX					mA
I _{CC} Supply current (driver and receiver combined)	VCC = MAX, V _O = 12 V	TA = MAX					mA

† 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 V_{CC} = 5 V and T_A = 25°C.

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

SN55116, SN75116 THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

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

driver section

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high level output	See Figure 13			14	30	ns
t_{PHL}	Propagation delay time, high-to-low level output				12	30	
t_{PZH}	Output enable time to high level	$R_L = 180\ \Omega$,	See Figure 14		8	20	ns
t_{PZL}	Output enable time to low level	$R_L = 250\ \Omega$,	See Figure 15		17	40	ns
t_{PHZ}	Output disable time from high level	$R_L = 180\ \Omega$,	See Figure 14		16	30	ns
t_{PLZ}	Output disable time from low level	$R_L = 250\ \Omega$,	See Figure 15		20	35	ns

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

PARAMETER	TEST CONDITIONS†	'116, SN75118		SN75117, SN75119		UNIT
		MIN	TYP‡	MAX	MIN	
V _{T+} Positive-going threshold voltage§	V _O = 0.4 V, See Note 3 I _{OL} = 15 mA,	VCC = MIN, V _{ICR} = 0, See Note 4		0.5		V
		VCC = 5 V, V _{ICR} = MAX, See Note 5		1		
V _{T-} Negative-going threshold voltage§	V _O = 2.4 V, See Note 3 I _{OL} = -5 mA,	VCC = MIN, V _{ICR} = 0, See Note 4		-0.5¶		V
		VCC = 5 V, V _{ICR} = MAX, See Note 5		-1¶		
V _I Input voltage range#	VCC = 5 V, V _{ID} = -1 V or 1 V, See Note 3	15 to -15		6 to 0		V
V _{OH} High-level output voltage	VCC = MIN, V _{ICR} = 0, See Note 3 I _{OH} = -5 mA, See Note 3	V _{ID} = -0.5 V, See Notes 4 and 6		2.4		V
		V _{ID} = -1 V, See Note 5		2.4		
V _{OL} Low-level output voltage	VCC = MIN, V _{ICR} = 0, See Note 3 I _{OL} = 15 mA, See Note 3	V _{ID} = 0.5 V, See Notes 4 and 7		0.4		V
		V _{ID} = 1 V, See Note 5		0.4		
I _{I(rec)} Receiver input current	VCC = MAX, See Note 3	Other input at 0 V		-0.5		-1
		Other input at 2.4 V		-0.4		-0.8
		Other input at 0.4 V		0.1		0.3
I _I Input current at maximum input voltage	VCC = MIN, V _{stroke} = 4.5 V VCC = MAX, V _I = 5.5 V	'116, SN75117		5		5
		SN75118, SN75119		1		1

† Unless otherwise noted, V_{stroke} = 2.4 V. 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 VCC = 5 V, T_A = 25°C, and V_{IC} = 0.

§ Differential voltages are at the B input terminal with respect to the A input terminal. Neither receiver input of the SN75117 or SN75119 should be taken negative with respect to GND. The algebraic convention, where the less positive (more negative) limit is designated as minimum, is used in this data sheet for threshold voltages only.

Input voltage range is the voltage range that, if exceeded at either input, will cause the receiver to cease functioning properly.

NOTES: 3. Measurement of these characteristics on the SN75117 and SN75119 requires the driver to be disabled with the driver enable at 0.8 V.

4. This applies with the less positive receiver input grounded.

5. For '116 and SN75118, this applies with the more positive receiver input at 15 V or the more negative receiver input at -15 V. For SN75117 and SN75119, this applies with the more positive receiver input at 6 V.

6. For SN55116, V_{ID} = -1 V.

7. For SN55116, V_{ID} = 1 V.

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

PARAMETER	TEST CONDITIONS†	'116, SN75118		SN75117, SN75119		UNIT	
		MIN	TYP‡	MAX	MIN		TYP‡
I _{IH} High-level input current	Enable V _{CC} = MAX, V _I = 2.4 V			40		40	μA
I _L Low-level input current	Strobe V _{CC} = MAX, V _{strobe} = 0.4 V See Notes 4 and 7			-2.4		-2.4	mA
	Enable V _{CC} = MAX, V _I = 0.4 V			-1.6		-1.6	
I(RC) Response-time-control current (RTO)	V _{CC} = MAX, RC at 0 V, V _{ID} = 0.5 V, See Notes 4 and 7			-1.2			mA
I _{O(off)} Off-state open-collector output current	TA = 25°C		1	10			
	V _{CC} = MAX, V _O = 12 V, V _{ID} = -1 V			200			μA
	SN55116, SN75_			20			
I _{OZ} Off-state (high-impedance state) output current	TA = 25°C			±10		±10	μA
	V _{CC} = MAX, V _O = 0 to V _{CC} , RE at 0.4 V			±20		±20	
R _T Line-terminating resistance	V _{CC} = 5 V		77	167			Ω
I _{OS} Short-circuit output current§	V _{CC} = MAX, V _{ID} = -0.5 V, See Notes 4 and 6			-15		-15	mA
	V _O = 0, See Notes 4 and 6			-80		-80	
I _{CC} Short current (driver and receiver combined)	V _{CC} = MAX, See Notes 4 and 7		42	60		42 60	mA

† Unless otherwise noted V_{strobe} = 2.4 V. 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 V_{CC} = 5 V, TA = 25°C, and V_I = 0.

§ Not more than one output should be shorted at a time.

NOTES: 4. This applies with the less positive receiver input grounded.

6. For SN55116, V_{ID} = -1 V.

7. For SN55116, V_{ID} = 1 V.

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

receiver section

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT	
t_{PLH}	Propagation delay time, low-to-high-level output	$R_L = 400\ \Omega$,	See Figure 16		20	75	ns	
t_{PHL}	Propagation delay time, high-to-low-level output				17	75	ns	
t_{PZH}	Output enable time to high level	$R_L = 480\ \Omega$,	See Figure 14		9	20	ns	
t_{PZL}	Output enable time to low level	SN75118 and SN75119 only	$R_L = 250\ \Omega$,	See Figure 15		16	35	ns
t_{PHZ}	Output disable time from high level		$R_L = 480\ \Omega$,	See Figure 14		12	30	ns
t_{PLZ}	Output disable time from low level		$R_L = 250\ \Omega$,	See Figure 15		17	35	ns

TYPICAL CHARACTERISTICS

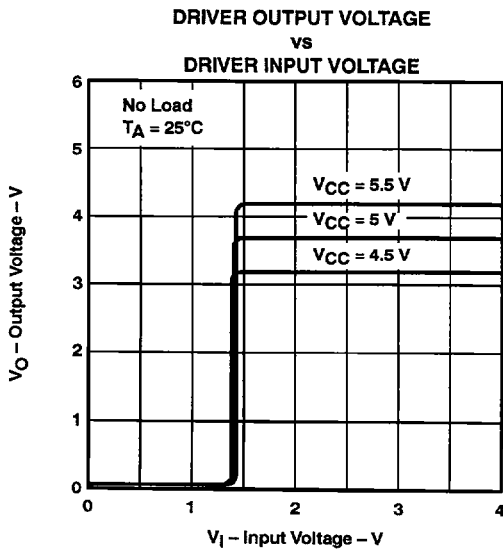


Figure 1

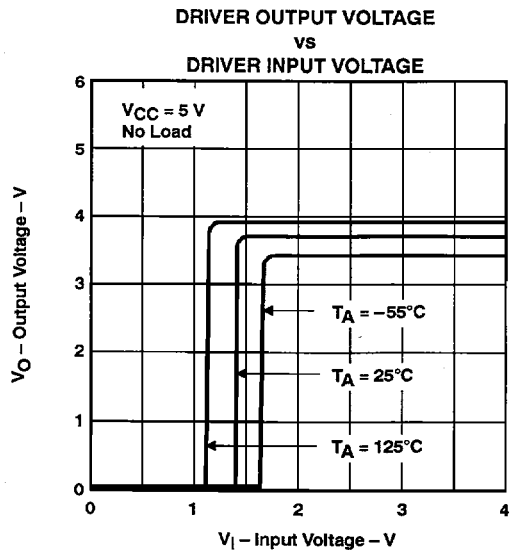


Figure 2

SN55116, SN75116 THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

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TYPICAL CHARACTERISTICS

DRIVER HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

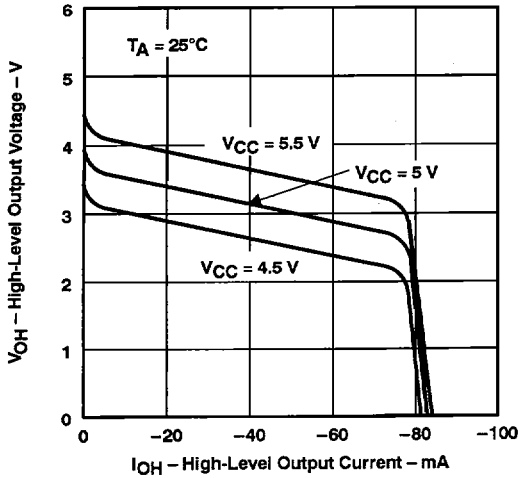


Figure 3

DRIVER LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

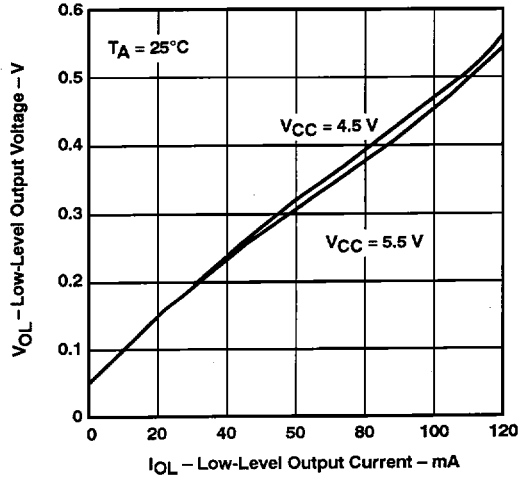


Figure 4

DRIVER PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE†

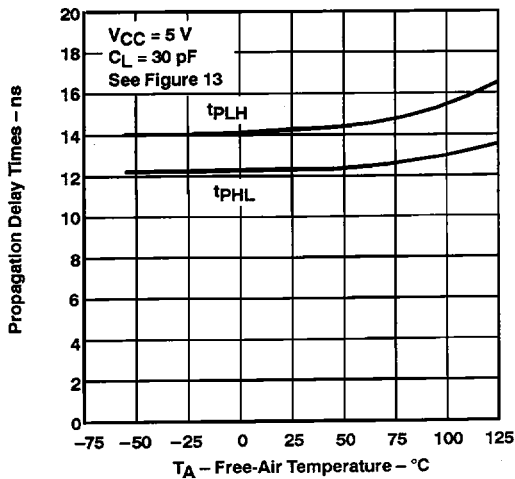


Figure 5

DRIVER OUTPUT ENABLE AND DISABLE TIMES
vs
FREE-AIR TEMPERATURE†

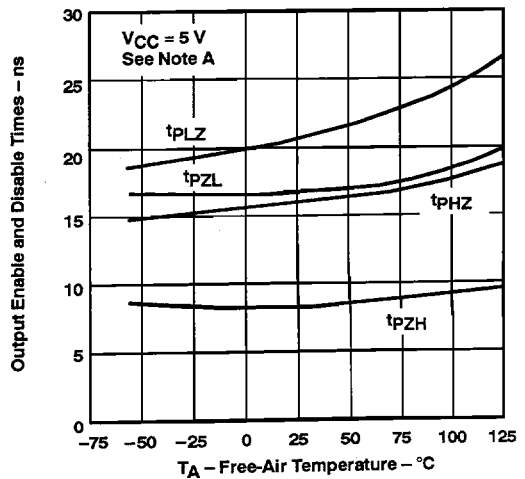


Figure 6

† Data for temperatures below 0°C and above 70°C are applicable to SN55116.

NOTE A: For t_{PZH} and t_{PHZ} : $R_L = 180 \Omega$, see Figure 14. For t_{PZL} and t_{PLZ} : $R_L = 250 \Omega$, see Figure 15.

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TYPICAL CHARACTERISTICS

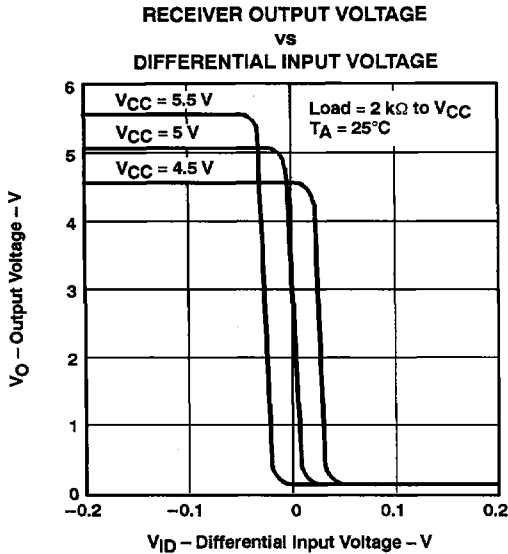


Figure 7

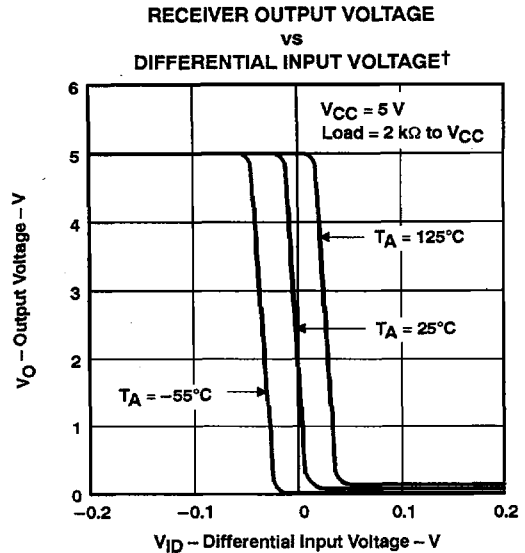


Figure 8

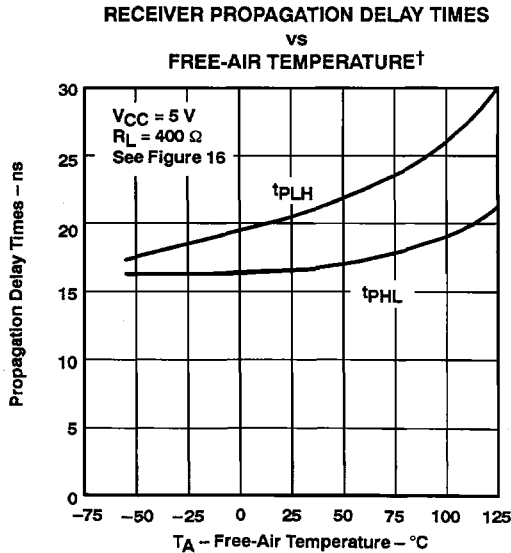


Figure 9

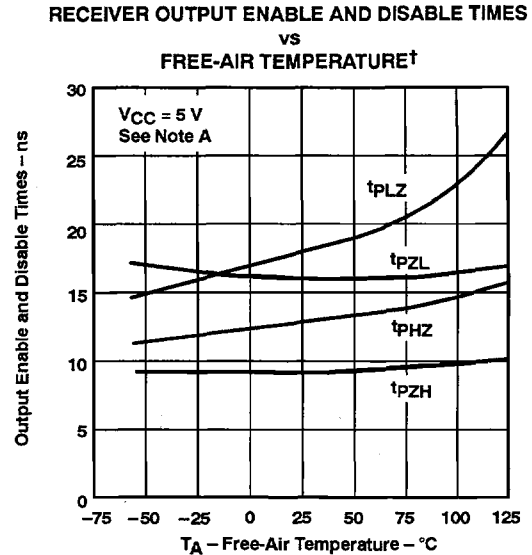


Figure 10

† Data for temperatures below 0°C and above 70°C are applicable to SN55116.

NOTE A: For t_{PZH} and t_{PHZ} : $R_L = 480\ \Omega$, see Figure 14. For t_{PZL} and t_{PLZ} : $R_L = 250\ \Omega$, see Figure 15.

SN55116, SN75116 THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

SLLS073A - D2143, MAY 1976 - REVISED FEBRUARY 1993

TYPICAL CHARACTERISTICS

SUPPLY CURRENT (DRIVER AND RECEIVER)
vs
SUPPLY VOLTAGE

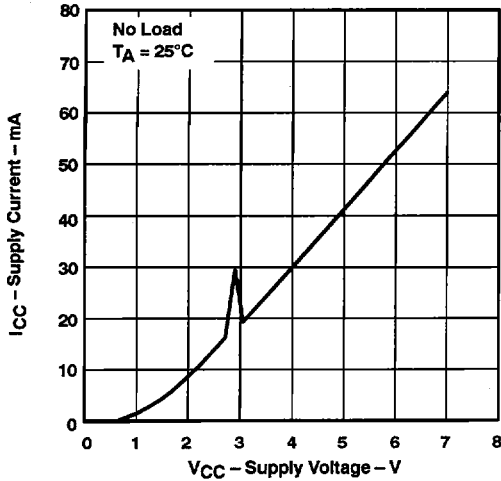


Figure 11

SUPPLY CURRENT (DRIVER AND RECEIVER)
vs
FREE-AIR TEMPERATURE†

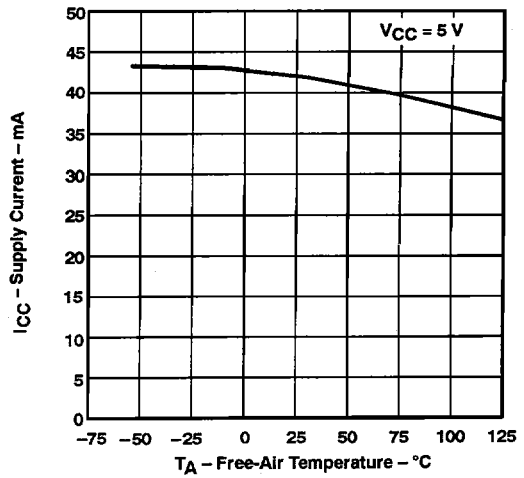


Figure 12

† Data for temperatures below 0°C and above 70°C are applicable to SN55116.

SN55116, SN75116 THRU SN75119 DIFFERENTIAL LINE TRANSCEIVERS

SLLS073A - D2143, MAY 1976 - REVISED FEBRUARY 1993

PARAMETER MEASUREMENT INFORMATION

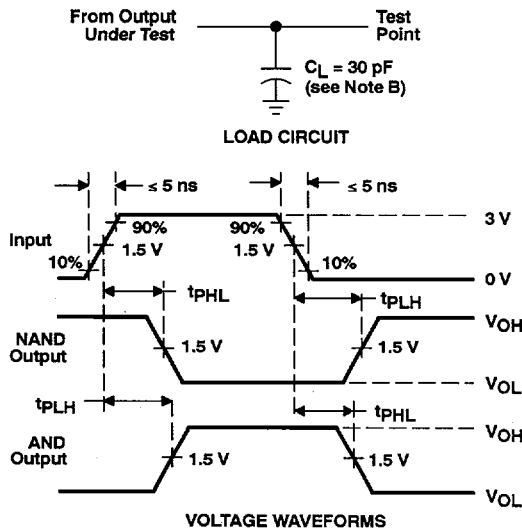


Figure 13. t_{PLH} and t_{PHL} (drivers only)

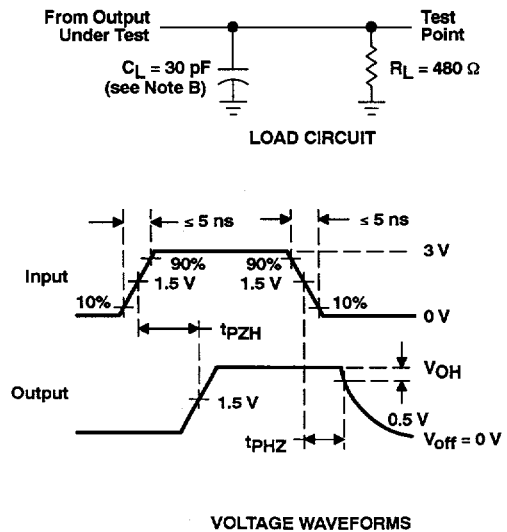


Figure 14. t_{PZH} and t_{PHZ}

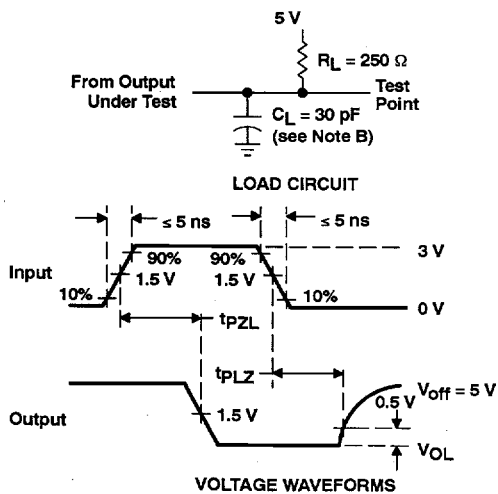


Figure 15. t_{PZL} and t_{PLZ}

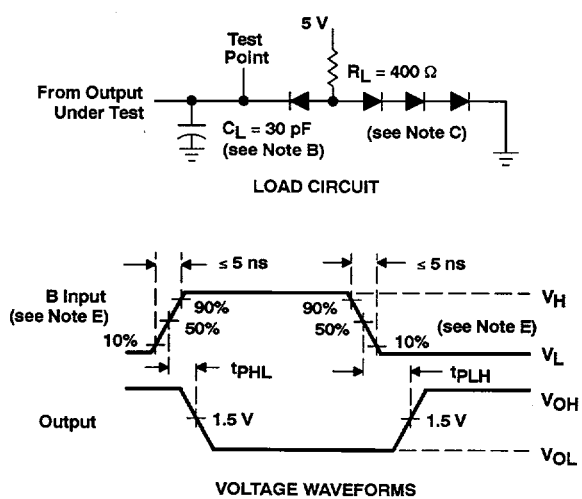


Figure 16. t_{PLH} and t_{PHL} (receivers only)

- NOTES: A. Input pulses are supplied by generators having 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.
 C. All diodes are 1N3064 or equivalent.
 D. When testing the '116 and SN75118 receiver sections, the response-time control and the termination resistor pins are left open.
 E. For '116 and SN75118, $V_H = 3\text{ V}$, $V_L = -3\text{ V}$, the A input is at 0 V.
 For SN75117 and SN75119, $V_H = 3\text{ V}$, $V_L = 0$, the A input is at 1.5 V.