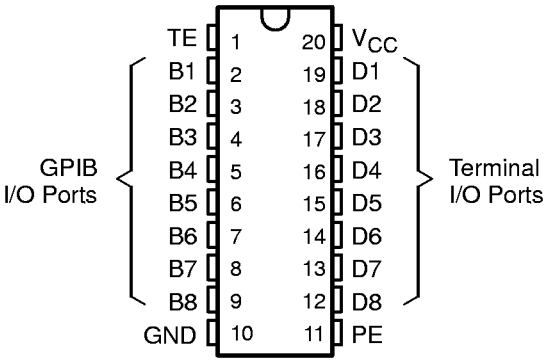
SLLS018D – JUNE 1986 – REVISED MAY 1995

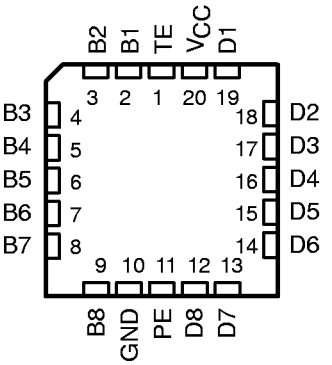
SUITABLE FOR IEEE STANDARD 488-1978 (GPIB)†

- 8-Channel Bidirectional Transceivers
- High-Speed Advanced Low-Power Schottky (ALS) Circuitry
- Low Power Dissipation:
  - SN55ALS160 . . . 56 mW Max Per Channel
  - SN75ALS160 . . . 46 mW Max Per Channel
- Fast Propagation Times . . . 20 ns Max
- High-Impedance pnp Inputs
- Receiver Hysteresis:
  - SN55ALS160 . . . 550 mV Typ
  - SN75ALS160 . . . 650 mV Typ
- Open-Collector Driver Output Option
- No Loading of Bus When Device Is Powered Down (V_{CC} = 0)
- Power-Up/Power-Down Protection (Glitch Free)

SN55ALS160 . . . J OR W PACKAGE
SN75ALS160 . . . DW OR N PACKAGE
(TOP VIEW)



SN55ALS160 . . . FK PACKAGE
(TOP VIEW)



description

The SN55ALS160 and SN75ALS160 eight-channel general-purpose interface bus transceivers are monolithic, high-speed, advanced low-power Schottky (ALS) devices designed for two-way data communications over single-ended transmission lines. They are designed to meet the requirements of IEEE Standard 488-1978. The transceivers feature driver outputs that can be operated in either the passive-pullup or 3-state mode. If talk enable (TE) is high, these ports have the characteristics of passive-pullup outputs when pullup enable (PE) is low and of 3-state outputs when PE is high. Taking TE low places these ports in the high-impedance state. The driver outputs are designed to handle loads up to 48 mA of sink current.

An active turn-off feature has been incorporated into the bus-terminating resistors so that the device exhibits a high impedance to the bus when V_{CC} = 0. When combined with the SN55ALS161, SN75ALS161, or SN75ALS162 bus management transceiver, the pair provides the complete 16-wire interface for the IEEE-488 bus.

The SN55ALS160 is characterized for operation from –55°C to 125°C. The SN75ALS160 is characterized for operation from 0°C to 70°C.

† The transceivers are suitable for IEEE Standard 896 applications to the extent of the operating conditions and characteristics specified in this data sheet. Certain limits contained in the IEEE specification are not met or cannot be tested over the entire military temperature range.

Function Tables

EACH DRIVER

INPUTS			OUTPUT
D	TE	PE	B
H	H	H	H
L	H	X	L
H	X	L	Z‡
X	L	X	Z‡

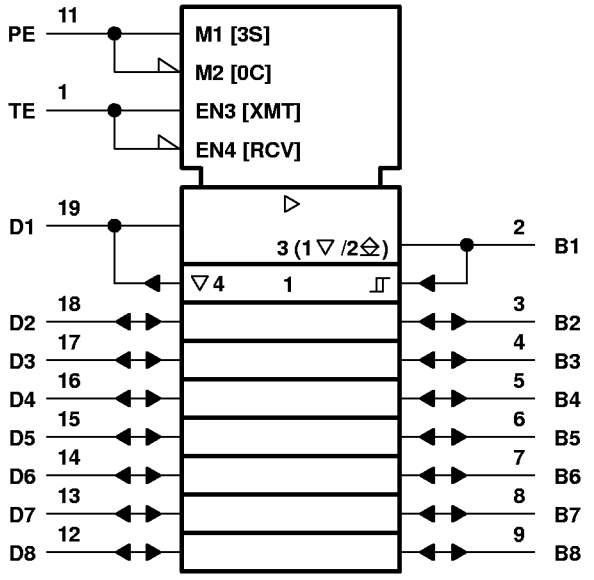
EACH RECEIVER

INPUTS			OUTPUT
B	TE	PE	D
L	L	X	L
H	L	X	H
X	H	X	Z

H = high level, L = low level, X = irrelevant,
Z = high-impedance state

† This is the high-impedance state of a normal 3-state output modified by the internal resistors to V_{CC} and GND.

logic symbol‡

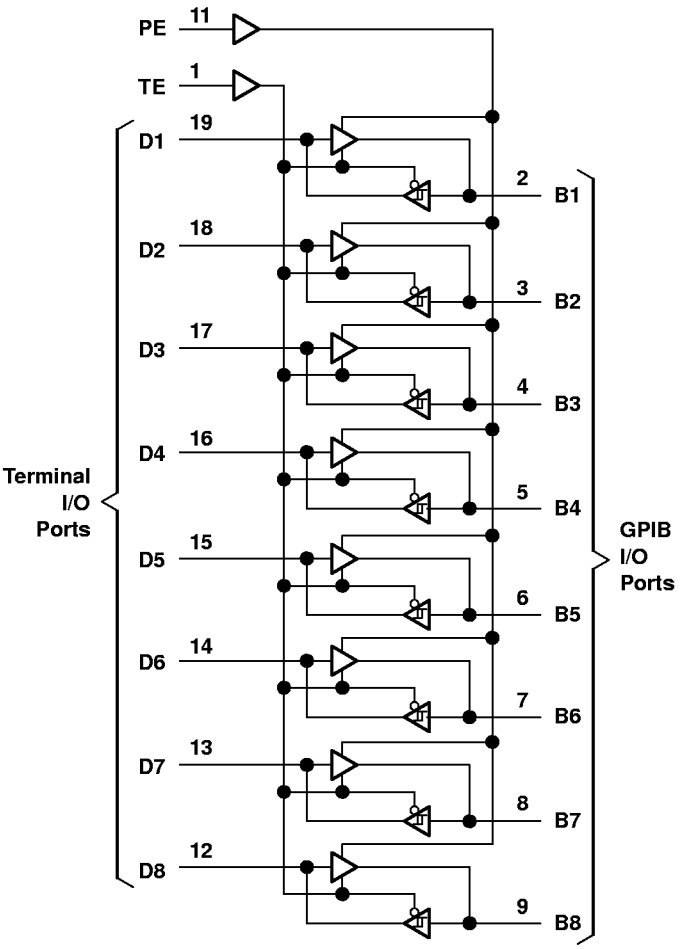


‡ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

▽ Designates 3-state outputs

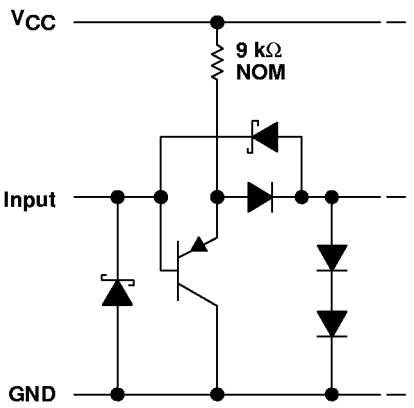
◈ Designates open-collector outputs with passive pullup

logic diagram (positive logic)

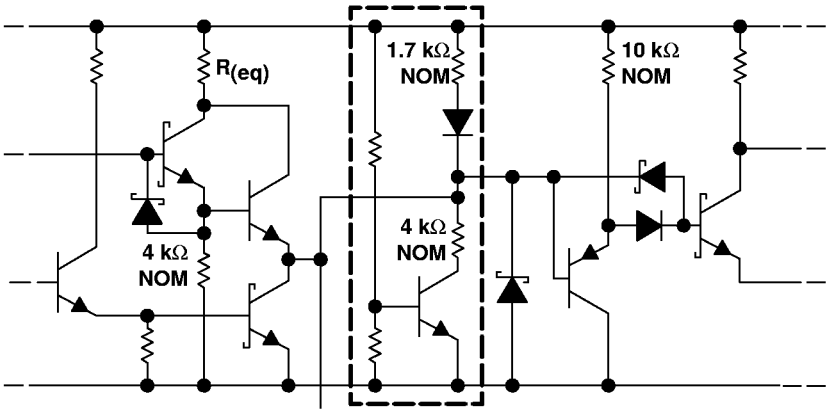


schematics of inputs and outputs

EQUIVALENT OF ALL CONTROL INPUTS



EQUIVALENT OF ALL INPUT/OUTPUT PORTS



Driver output $R_{(eq)}$ = 30 Ω NOM
Receiver output $R_{(eq)}$ = 110 Ω NOM
$R_{(eq)}$ = equivalent resistor
Circuit inside dashed lines is on the driver outputs only.

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
Low-level driver output current, I_{OL} . . . . . 100 mA
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: SN55ALS160 . . . . . –55°C to 125°C
SN75ALS160 . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
Case temperature for 60 seconds, T_C: FK package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from the case for 10 seconds: DW or N package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from the 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.

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

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR	$T_A = 70°C$ POWER RATING	$T_A = 125°C$ POWER RATING
DW	1125 mW	9.0 mW/°C	720 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	—
W	1000 mW	8.0 mW/°C	640 mW	200 mW

SN55ALS160 recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
High-level input voltage, V_{IH}	TE and PE at T_A = −55°C to 125°C	2			V
	Bus and terminal at T_A = 25°C to 125°C	2			
	Bus and terminal at T_A = −55°C	2.1			
Low-level input voltage, V_{IL}	TE and PE at T_A = −55°C to 125°C			0.8	V
	Bus and terminal at T_A = 25°C to −55°C			0.8	
	Bus and terminal at T_A = 125°C			0.7	
High-level output current, I_{OH}	Bus ports with pullups active (V_{CC} = 5 V)			– 5.2	mA
	Terminal ports			– 800	µA
Low-level output current, I_{OL}	Bus ports			48	mA
	Terminal ports			16	
Operating free-air temperature, T_A		−55		125	°C

SN75ALS160 recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
High-level input voltage, V_{IH}		2			V
Low-level input voltage, V_{IL}				0.8	V
High-level output current, I_{OH}	Bus ports with pullups active			– 5.2	mA
	Terminal ports			– 800	µA
Low-level output current, I_{OL}	Bus ports			48	mA
	Terminal ports			16	
Operating free-air temperature, T_A		0		70	°C

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

PARAMETER			TEST CONDITIONS†			SN55ALS160			SN75ALS160			UNIT
						MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}	Input clamp voltage		I_I = –18 mA,	V_{CC} = MIN			–0.8	–1.5		–0.8	–1.5	V
V_{hys}	Hysteresis voltage ($V_{IT+} - V_{IT-}$)	Bus							0.4	0.65		V
		Bus	V_{CC} = 5 V,	T_A = –55°C and 25°C		0.4	0.55					
			V_{CC} = 5 V,	T_A = 125°C		0.25						
V_{OH}§	High-level output voltage	Terminal	I_{OH} = –800 µA,	TE at 0.8 V,	V_{CC} = MIN	2.7	3.5		2.7	3.5		V
		Bus	I_{OH} = –5.2 mA,	PE and TE at 2 V,	V_{CC} = MIN	2.5	3.3		2.5	3.3		
V_{OL}	Low-level output voltage	Terminal	I_{OL} = 16 mA,	TE at 0.8 V,	V_{CC} = MIN		0.3	0.5		0.3	0.5	V
		Bus	I_{OL} = 48 mA,	TE at 2 V,	V_{CC} = MIN		0.35	0.5		0.35	0.5	
I_I	Input current at maximum input voltage	Terminal	V_I = 5.5 V,	V_{CC} = MAX			0.2	100		0.2	100	µA
I_{IH}	High-level input current	Terminal, PE, or TE	V_I = 2.7 V,	V_{CC} = MAX			0.1	20		0.1	20	µA
I_{IL}	Low-level input current		V_I = 0.5 V,	V_{CC} = MAX			–30	–100		–10	–100	µA
$V_{I/O(bus)}$	Voltage at bus port		Driver disabled, V_{CC} = 5 V (SN55')	$I_{I(bus)}$ = 0		2.5	3	3.7	2.5	3	3.7	V
				$I_{I(bus)}$ = –12 mA				–1.5			–1.5	
$I_{I/O(bus)}$	Current into bus port	Power on	Driver disabled, V_{CC} = 5 V (SN55')	$V_{I(bus)}$ = –1.5 V to 0.4 V		–1.3			–1.3			mA
				$V_{I(bus)}$ = 0.4 V to 2.5 V		0		–3.2	0		–3.2	
				$V_{I(bus)}$ = 2.5 V to 3.7 V				2.5 –3.2			2.5 –3.2	
				$V_{I(bus)}$ = 3.7 V to 5 V		0		2.5	0		2.5	
				$V_{I(bus)}$ = 5 V to 5.5 V		0.7		2.5	0.7		2.5	
		Power off	V_{CC} = 0	$V_{I(bus)}$ = 0 to 2.5 V				40			40	µA
I_{OS}	Short-circuit output current	Terminal	V_{CC} = MAX			–15	–35	–75	–15	–35	–75	mA
		Bus	V_{CC} = MAX			–25	–50	–125	–25	–50	–125	
I_{CC}	Supply current		No load, V_{CC} = MAX	Terminal outputs low and enabled			42	56		42	65	mA
				Bus outputs low and enabled			52	85		52	80	
$C_{I/O(bus)}$	Bus-port capacitance		V_{CC} = 0 to 5 V,	$V_{I/O}$ = 0 to 2 V,	f = 1 MHz		30			30		pF

† 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, T_A = 25°C.
§ V_{OH} applies to 3-state outputs only.

switching characteristics at V_{CC} = 4.75 V, 5 V, and 5.25 V, C_L = 50 pF (unless otherwise noted)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T_A†	MIN	TYP‡	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	Terminal	Bus	See Figure 1	25°C		10	17	ns
					Full range			20	
t_{PHL}	Propagation delay time, high- to low-level output				25°C		10	14	
					Full range			16	
t_{PLH}	Propagation delay time, low- to high-level output	Bus	Terminal	See Figure 2	25°C		8	15	ns
					Full range			18	
t_{PHL}	Propagation delay time, high- to low-level output				25°C		8	15	
					Full range			18	
t_{PZH}	Output enable time to high level	TE	Bus	See Figure 3	25°C		24	30	ns
					Full range			41	
t_{PHZ}	Output disable time from high level				25°C		9	14	
					Full range			16	
t_{PZL}	Output enable time to low level				25°C		16	28	
					Full range			34	
t_{PLZ}	Output disable time from low level				25°C		12	19	
					Full range			24	
t_{PZH}	Output enable time to high level	TE	Terminal	See Figure 4	25°C		24	36	ns
					Full range			50	
t_{PHZ}	Output disable time from high level				25°C		10	18	
					Full range			23	
t_{PZL}	Output enable time to low level				25°C		15	26	
					Full range			30	
t_{PLZ}	Output disable time from low level				25°C		15	24	
					Full range			31	ns
t_{en}	Output pullup enable time	PE	Bus	See Figure 5	25°C		16	24	
					Full range			25	
t_{dis}	Output pullup disable time				25°C		9	16	
					Full range			20	

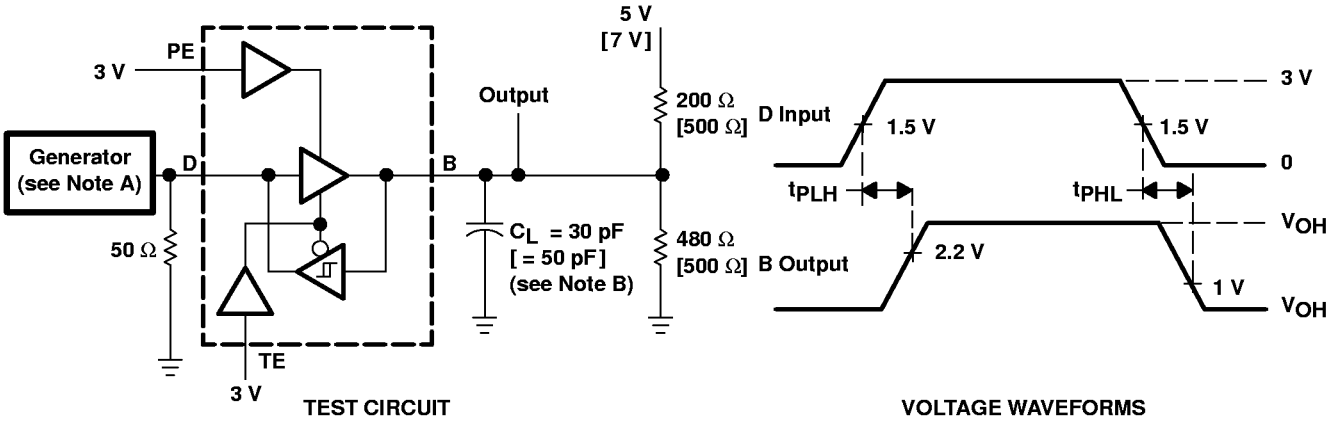
† Full range is −55°C to 125°C.
‡ All typical values are at V_{CC} = 5 V.

switching characteristics over recommended range of operating free-air temperature, V_{CC} = 5 V

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	Terminal	Bus	C_L = 30 pF, See Figure 1		7	20	ns
t_{PHL}	Propagation delay time, high- to low-level output					8	20	
t_{PLH}	Propagation delay time, low- to high-level output	Bus	Terminal	C_L = 30 pF, See Figure 2		7	14	ns
t_{PHL}	Propagation delay time, high- to low-level output					9	14	
t_{PZH}	Output enable time to high level	TE	Bus	C_L = 15 pF, See Figure 3		19	30	ns
t_{PHZ}	Output disable time from high level					5	12	
t_{PZL}	Output enable time to low level					16	35	
t_{PLZ}	Output disable time from low level					9	20	
t_{PZH}	Output enable time to high level	TE	Terminal	C_L = 15 pF, See Figure 4		13	30	ns
t_{PHZ}	Output disable time from high level					12	20	
t_{PZL}	Output enable time to low level					12	20	
t_{PLZ}	Output disable time from low level					11	20	
t_{en}	Output pullup enable time	PE	Bus	C_L = 15 pF, See Figure 5		11	22	ns
t_{dis}	Output pullup disable time					6	12	

† Typical values are at T_A = 25°C.

PARAMETER MEASUREMENT INFORMATION



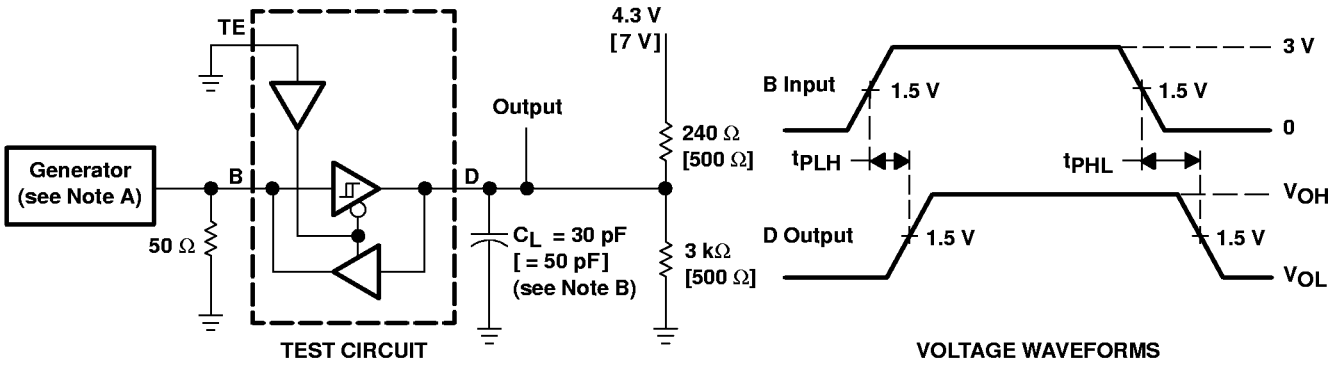
[ ] denotes the SN55ALS160 military test conditions.

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 1. Terminal-to-Bus Test Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

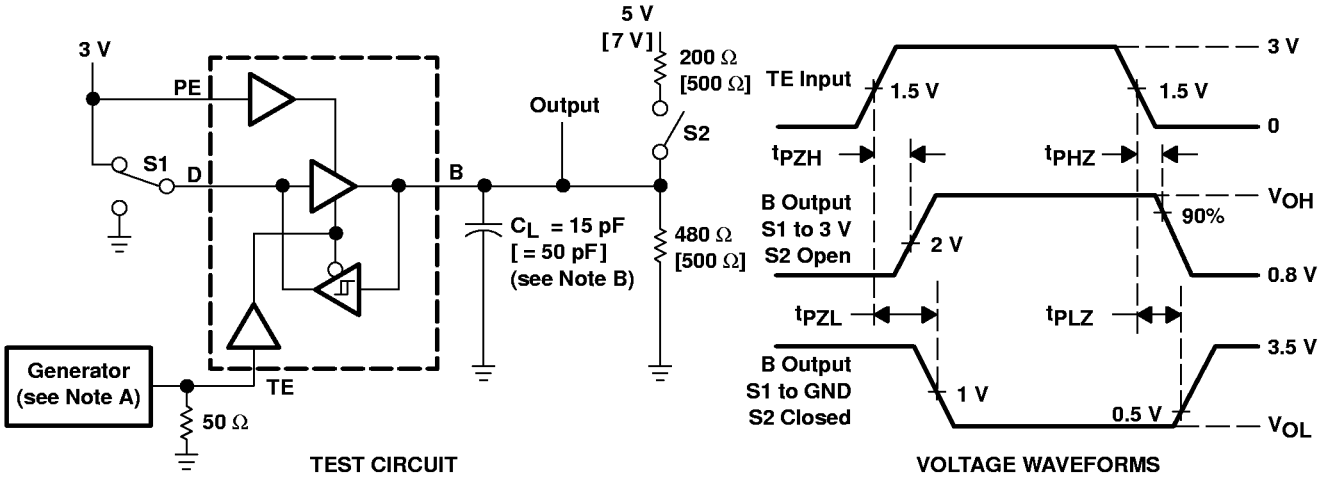


[ ] denotes the SN55ALS160 military test conditions.

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 2. Bus-to-Terminal Test Circuit and Voltage Waveforms



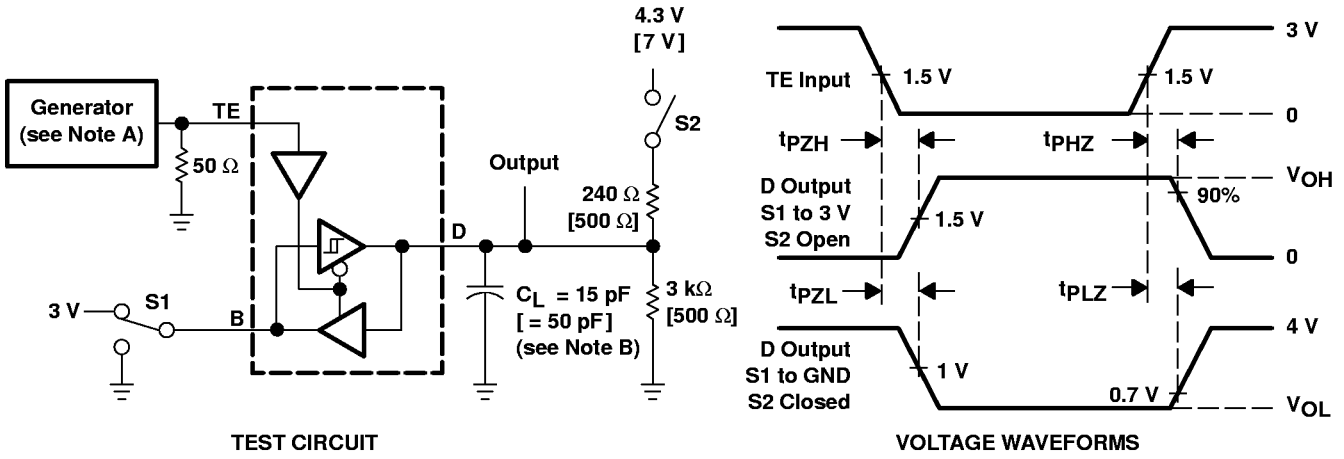
[ ] denotes the SN55ALS160 military test conditions.

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 3. TE-to-Bus Test Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION



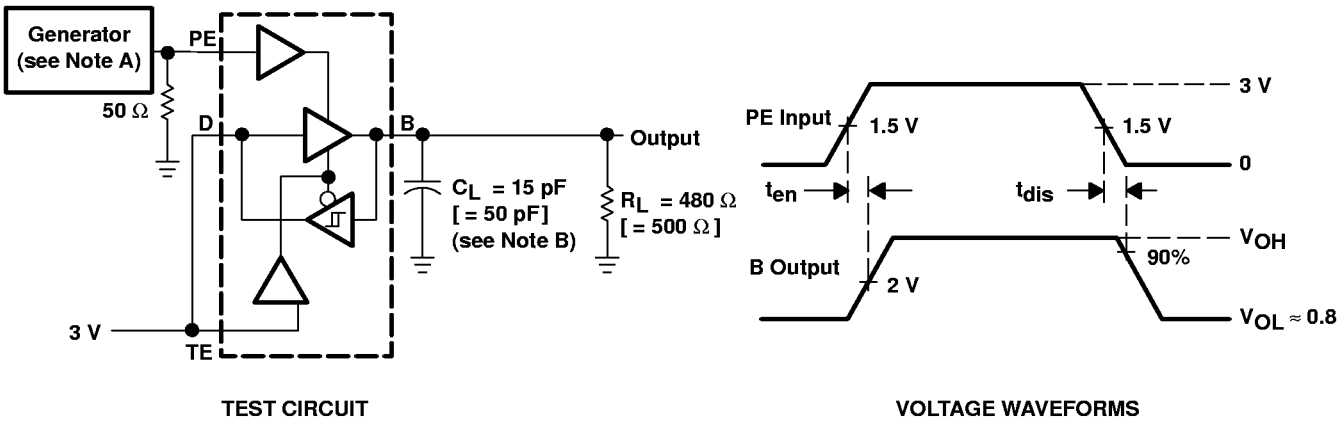
TEST CIRCUIT VOLTAGE WAVEFORMS

[ ] denotes the SN55ALS160 military test conditions.

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 4. TE-to-Terminal Test Circuit and Voltage Waveforms



TEST CIRCUIT VOLTAGE WAVEFORMS

[ ] denotes the SN55ALS160 military test conditions.

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 5. PE-to-Bus Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

TERMINAL HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

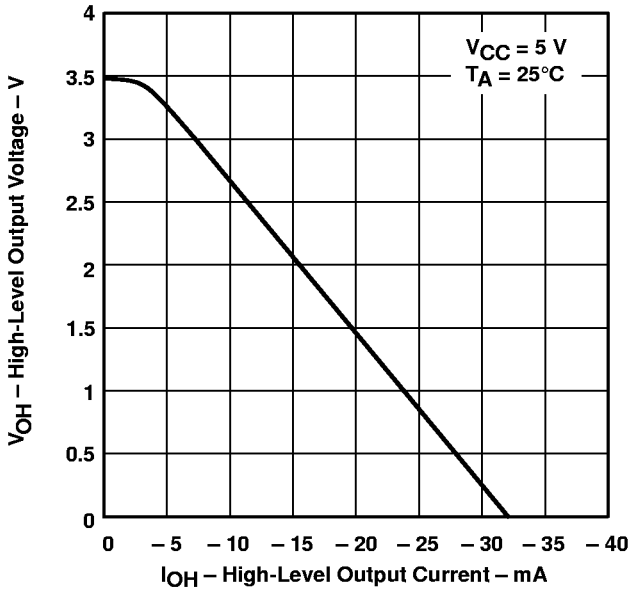


Figure 6

TERMINAL LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

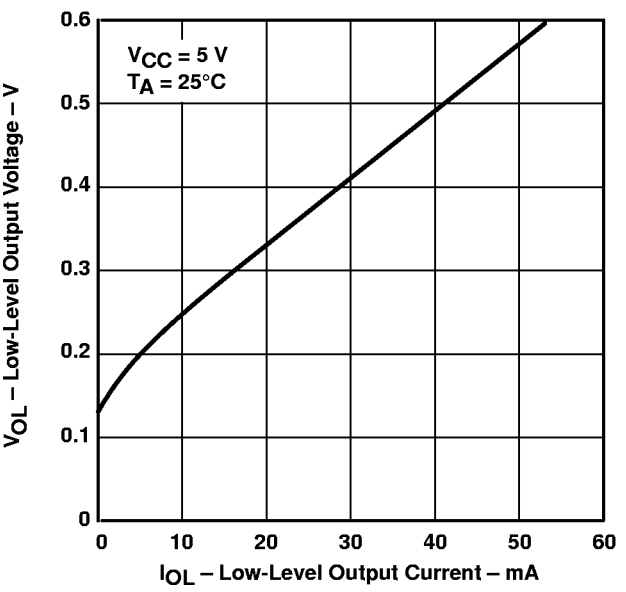


Figure 7

TERMINAL OUTPUT VOLTAGE vs BUS INPUT VOLTAGE

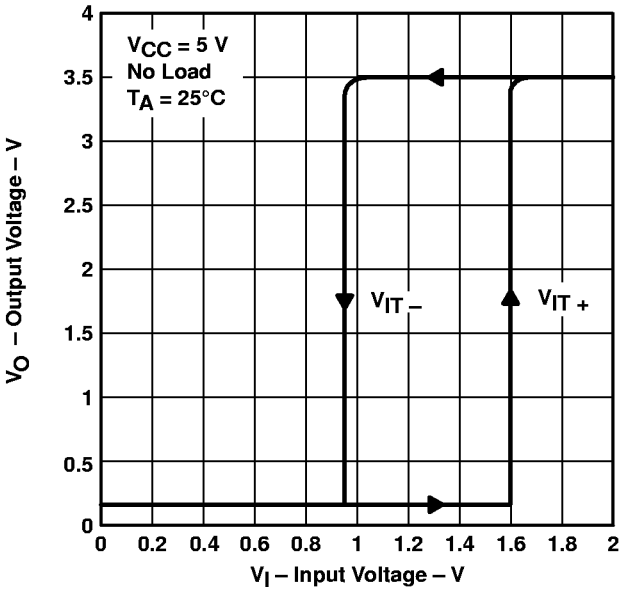


Figure 8

TYPICAL CHARACTERISTICS

BUS HIGH-LEVEL OUTPUT VOLTAGE vs BUS HIGH-LEVEL OUTPUT CURRENT

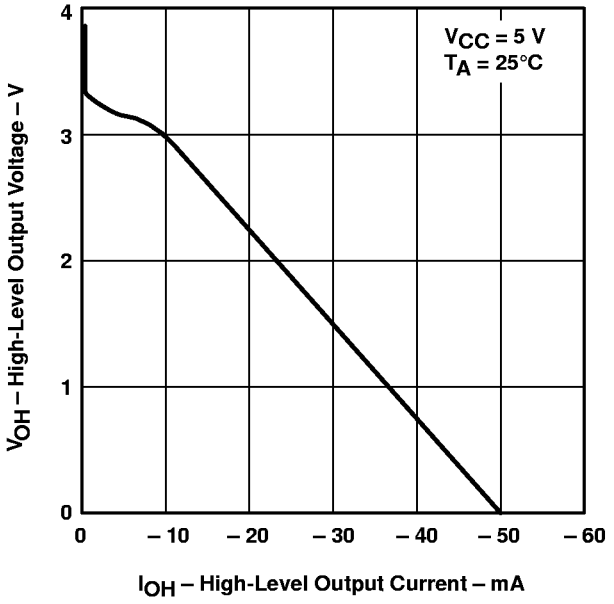


Figure 9

BUS LOW-LEVEL OUTPUT VOLTAGE vs BUS LOW-LEVEL OUTPUT CURRENT

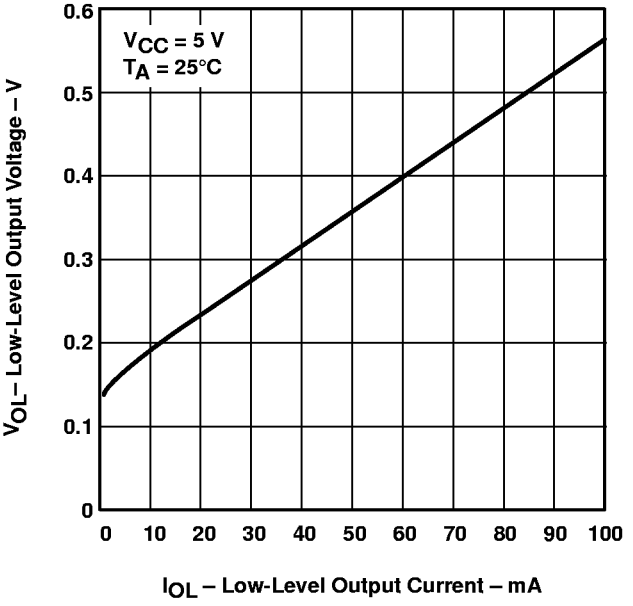


Figure 10

BUS OUTPUT VOLTAGE vs TERMINAL INPUT VOLTAGE

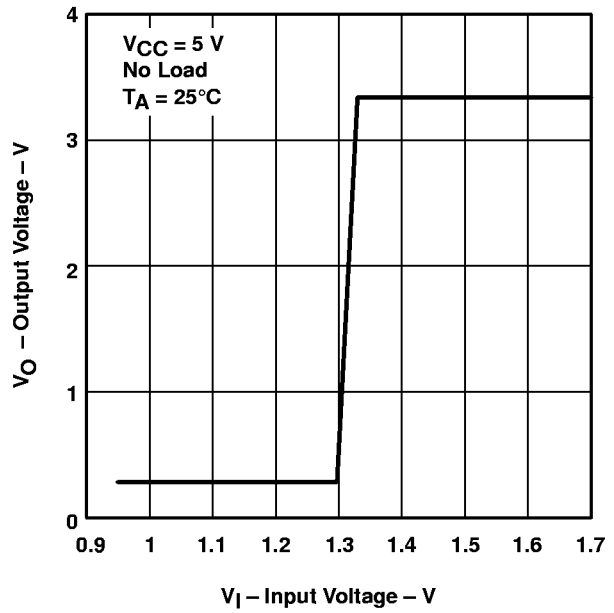


Figure 11

BUS CURRENT vs BUS VOLTAGE

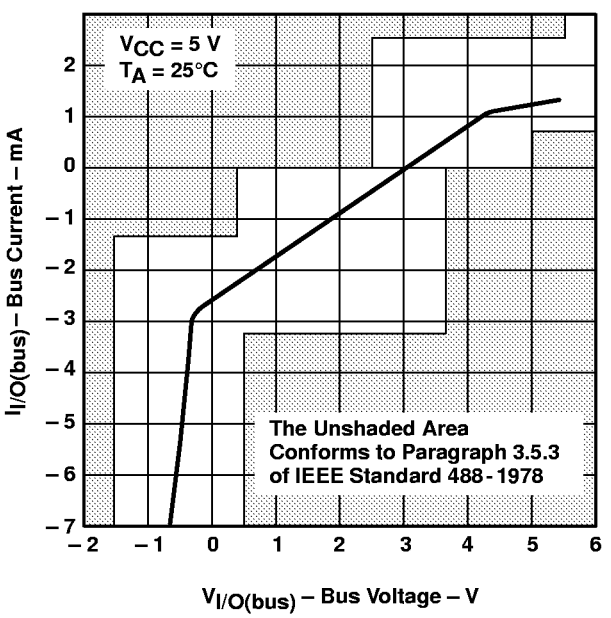


Figure 12

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