SN54251, SN54LS251, SN54S251, SN74251, SN74LS251, (TIM9905), SN74S251
DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SDLS085 – DECEMBER 1972 – REVISED MARCH 1988

- Three-State Versions of '151, 'LS151, 'S151
- Three-State Outputs Interface Directly with System Bus
- Perform Parallel-to-Serial Conversion
- Permit Multiplexing from N-lines to One Line
- Complementary Outputs Provide True and Inverted Data
- Fully Compatible with Most TTL Circuits

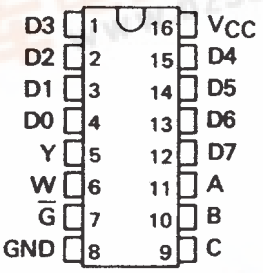
TYPE	MAX NO. OF COMMON OUTPUTS	TYPICAL AVG PROP DELAY TIME (D TO Y)	TYPICAL POWER DISSIPATION
SN54251	49	17 ns	250 mW
SN74251	129	17 ns	250 mW
SN54LS251	49	17 ns	35 mW
SN74LS251	129	17 ns	35 mW
SN54S251	39	8 ns	275 mW
SN74S251	129	8 ns	275 mW

description

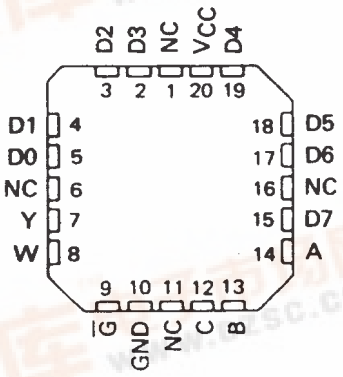
These monolithic data selectors/multiplexers contain full on-chip binary decoding to select one-of-eight data sources and feature a strobe-controlled three-state output. The strobe must be at a low logic level to enable these devices. The three-state outputs permit a number of outputs to be connected to a common bus. When the strobe input is high, both outputs are in a high-impedance state in which both the upper and lower transistors of each totem-pole output are off, and the output neither drives nor loads the bus significantly. When the strobe is low, the outputs are activated and operate as standard TTL totem-pole outputs.

To minimize the possibility that two outputs will attempt to take a common bus to opposite logic levels, the output control circuitry is designed so that the average output disable time is shorter than the average output enable time. The SN54251 and SN74251 have output clamp diodes to attenuate reflections on the bus line.

SN54251, SN54LS251, SN54S251 . . . J OR W PACKAGE
SN74251 . . . N PACKAGE
SN74LS251, SN74S251 . . . D OR N PACKAGE
(TOP VIEW)



SN54LS251, SN54S251 . . . FK PACKAGE
(TOP VIEW)



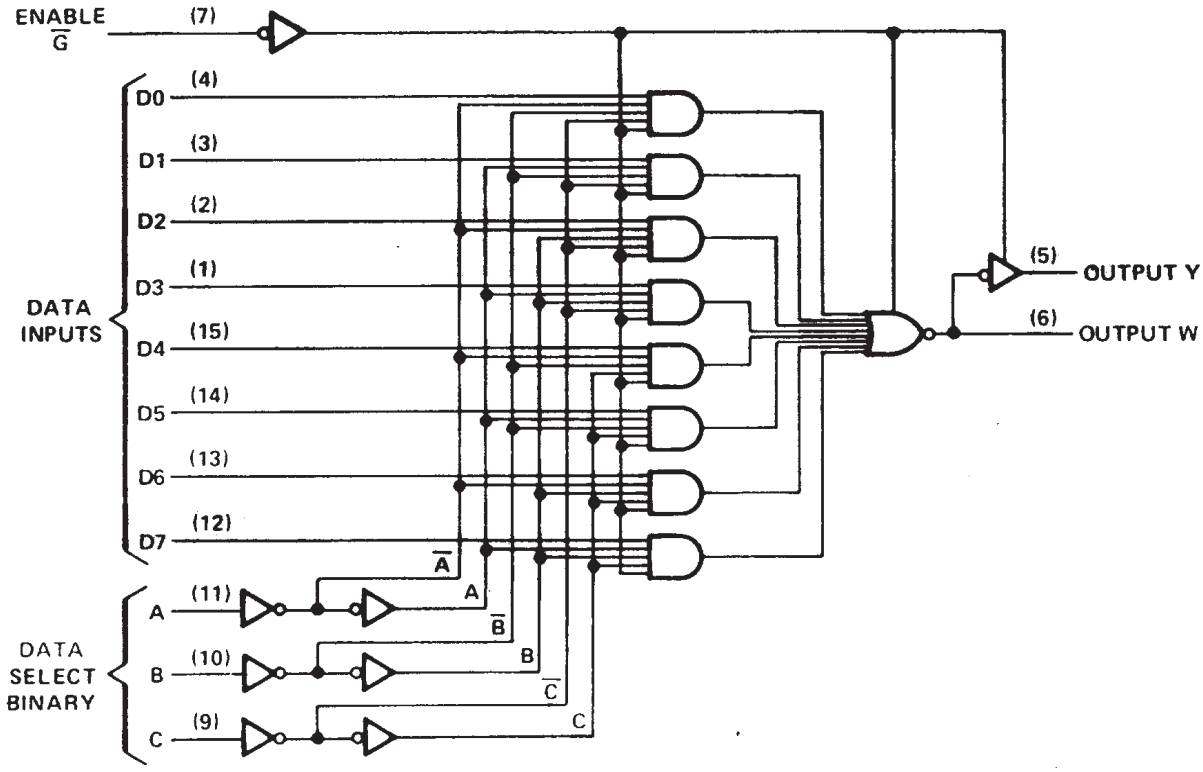
NC – No internal connection

FUNCTION TABLE

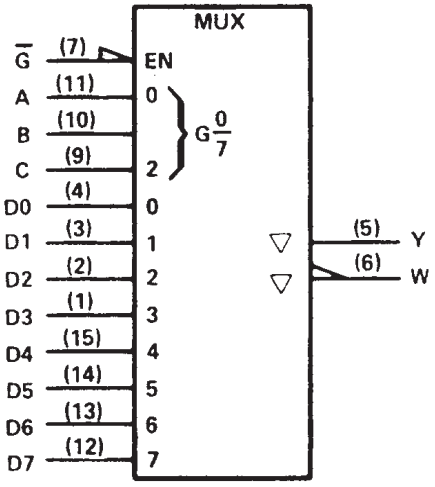
INPUTS				OUTPUTS	
SELECT			ENABLE		
C	B	A	$\overline{G}$	Y	W
X	X	X	H	Z	Z
L	L	L	L	D0	$\overline{D0}$
L	L	H	L	D1	$\overline{D1}$
L	H	L	L	D2	$\overline{D2}$
L	H	H	L	D3	$\overline{D3}$
H	L	L	L	D4	$\overline{D4}$
H	L	H	L	D5	$\overline{D5}$
H	H	L	L	D6	$\overline{D6}$
H	H	H	L	D7	$\overline{D7}$

H = high logic level, L = low logic level
X = irrelevant, Z = high impedance (off)
D0, D1 . . . D7 = the level of the respective D input

logic diagram (positive logic)



logic symbol†



†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Off-state output voltage . . . . . 5.5 V
Operating free-air temperature range: SN54251 . . . . . −55°C to 125°C
SN74251 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

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

recommended operating conditions

	SN54251			SN74251			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			−2			−5.2	mA
Low-level output current, I_{OL}			16			16	mA
Operating free-air temperature, T_A	−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = −12 mA				−1.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = MAX		2.4	3.2		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 16 mA			0.2	0.4	V
I_{OZ}	Off-state (high-impedance-state) output current	V_{CC} = MAX, V_{IH} = 2 V	V_O = 2.4 V			40	μA
			V_O = 0.4 V			−40	
V_O	Output clamp voltage	V_{CC} = MAX, V_{IH} = 4.5 V	I_O = −12 mA			−1.5	V
			I_O = 12 mA			V_{CC}+1.5	
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 5.5 V				1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.4 V				40	μA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.4 V				−1.6	mA
I_{OS}	Short-circuit output current§	V_{CC} = MAX		−18		−55	mA
I_{CC}	Supply current	V_{CC} = MAX, All outputs open	All inputs at 4.5 V,		38	62	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time.

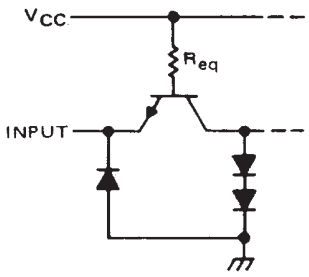
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	A, B, or C (4 levels)	Y	C_L = 50 pF, R_L = 400 Ω, See Note 2		29	45	ns
t_{PHL}					28	45	
t_{PLH}	A, B, or C (3 levels)	W			20	33	ns
t_{PHL}					21	33	
t_{PLH}	Any D	Y			17	28	ns
t_{PHL}					18	28	
t_{PLH}	Any D	W			10	15	ns
t_{PHL}					9	15	
t_{PZH}	$\overline{G}$	Y			17	27	ns
t_{PZL}					26	40	
t_{PZH}	$\overline{G}$	W			17	27	ns
t_{PZL}					24	40	
t_{PHZ}	$\overline{G}$	Y	C_L = 5 pF, R_L = 400 Ω, See Note 2		5	8	ns
t_{PLZ}					15	23	
t_{PHZ}	$\overline{G}$	W			5	8	ns
t_{PLZ}					15	23	

†t_{PLH} = Propagation delay time, low-to-high-level output
t_{PHL} = Propagation delay time, high-to-low-level output
t_{PZH} = Output enable time to high level
t_{PZL} = Output enable time to low level
t_{PHZ} = Output disable time from high level
t_{PLZ} = Output disable time from low level
NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

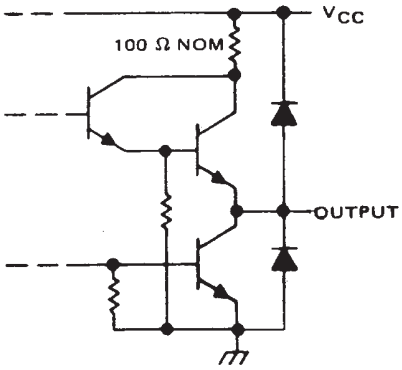
schematics of inputs and outputs

EQUIVALENT OF EACH INPUT



Select: R_{eq} = 6 kΩ NOM
Other inputs: R_{eq} = 4 kΩ NOM

TYPICAL OF BOTH OUTPUTS



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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 7 V
Off-state output voltage . . . . . 5.5 V
Operating free-air temperature range: SN54LS251 . . . . . 55°C to 125°C
SN74LS251 . . . . . 0°C to 70°C
Storage temperature range . . . . . –65°C to 150°C

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

recommended operating conditions

		SN54LS251			SN74LS251			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.7			0.8	V
I_{OH}	High-level output current			– 1			– 2.6	mA
I_{OL}	Low-level output current			4			8	mA
T_A	Operating free-air temperature	– 55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†		SN54LS251			SN74LS251			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}		V_{CC} = MIN, I_I = – 18 mA				– 1.5			– 1.5	V
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX, I_{OH} = MAX		2.4	3.4		2.4	3.1		V
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 8 mA					0.35	0.5	
I_{OZ}		V_{CC} = MAX, V_{IH} = 2 V	V_O = 2.7 V			20			20	μA
			V_O = 0.4 V			–20			– 20	
I_I		V_{CC} = MAX, V_I = 7 V				0.1			0.1	mA
I_{IH}		V_{CC} = MAX, V_I = 2.7 V				20			20	μA
I_{IL}	Enable $\overline{G}$	V_{CC} = MAX, V_I = 0.4				– 0.2			– 0.2	mA
	All other					– 0.4			– 0.4	
I_{OS}§		V_{CC} = MAX		– 30		– 130	– 30		– 130	mA
I_{CC}		V_{CC} = MAX, See Note 3	Condition A		6.1	10		6.1	10	mA
			Condition B		7.1	12		7.1	12	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
‡ All typical values are at V_{CC} = 5 V, 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.
NOTE 3: I_{CC} is measured with the outputs open and all data and select inputs at 4.5 V under the following conditions:
A. Enable grounded.
B. Strobe at 4.5 V.

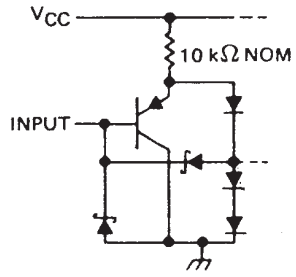
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	A, B, or C (4 levels)	Y	C_L = 15 pF, R_L = 2 kΩ, See Note 2		29	45	ns
t_{PHL}					28	45	
t_{PLH}	A, B, or C (3 levels)	W			20	33	ns
t_{PHL}					21	33	
t_{PLH}	Any D	Y			17	28	ns
t_{PHL}					18	28	
t_{PLH}	Any D	W			10	15	ns
t_{PHL}					9	15	
t_{PZH}	$\overline{G}$	Y			30	45	ns
t_{PZL}					26	40	
t_{PZH}	$\overline{G}$	W			17	27	ns
t_{PZL}					24	40	
t_{PHZ}	$\overline{G}$	Y	C_L = 5 pF, R_L = 2 kΩ, See Note 2		30	45	ns
t_{PLZ}					15	25	
t_{PHZ}	$\overline{G}$	W			37	55	ns
t_{PLZ}					15	25	

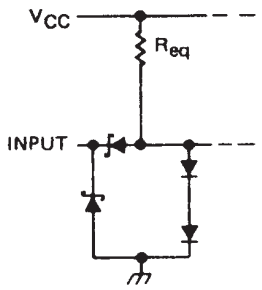
†t_{PLH} = Propagation delay time, low-to-high-level output
t_{PHL} = Propagation delay time, high-to-low-level output
t_{PZH} = Output enable time to high level
t_{PZL} = Output enable time to low level
t_{PHZ} = Output disable time from high level
t_{PLZ} = Output disable time from low level
NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs

EQUIVALENT OF $\overline{G}$ INPUT

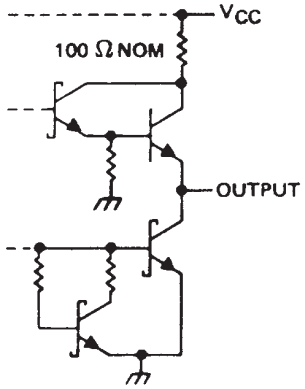


EQUIVALENT OF ALL OTHER INPUTS



A, B, C: R_{eq} = 20 kΩ NOM
D0 thru D7: R_{eq} = 17 kΩ NOM

TYPICAL OF BOTH OUTPUTS



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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Off-state output voltage . . . . . 5.5 V
Operating free-air temperature range: SN54S251 . . . . . −55°C to 125°C
SN74S251 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

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

recommended operating conditions

	SN54S251			SN74S251			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			−2			−6.5	mA
Low-level output current, I_{OL}			20			20	mA
Operating free-air temperature, T_A	−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†			MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage				2			V
V_{IL}	Low-level input voltage						0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = −18 mA					−1.2	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = MAX		SN54S'	2.4	3.4		V
				SN74S'	2.4	3.2		
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 20 mA					0.5	V
I_{OZ}	Off-state (high-impedance-state) output current	V_{CC} = MAX, V_{IH} = 2 V	V_O = 2.4 V				50	μA
			V_O = 0.5 V				−50	
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 5.5 V					1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.7 V					50	μA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.5 V					−2	mA
I_{OS}	Short-circuit output current§	V_{CC} = MAX			−40		−100	mA
I_{CC}	Supply current	V_{CC} = MAX, All outputs open	All inputs at 4.5 V,			55	85	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
‡All typical values are at V_{CC} = 5 V, 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.

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

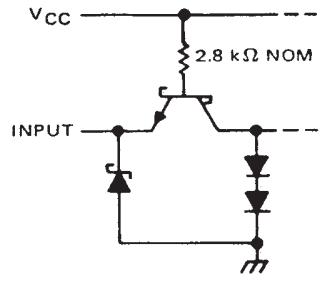
PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	A, B, or C (4 levels)	Y	C_L = 15 pF, R_L = 280 Ω, See Note 2		12	18	ns
t_{PHL}					13	19.5	
t_{PLH}	A, B, or C (3 levels)	W			10	15	ns
t_{PHL}					9	13.5	
t_{PLH}	Any D	Y			8	12	ns
t_{PHL}					8	12	
t_{PLH}	Any D	W			4.5	7	ns
t_{PHL}					4.5	7	
t_{PZH}	$\overline{G}$	Y	C_L = 50 pF, R_L = 280 Ω, See Note 2		13	19.5	ns
t_{PZL}					14	21	
t_{PZH}	$\overline{G}$	W			13	19.5	ns
t_{PZL}					14	21	
t_{PHZ}	$\overline{G}$	Y	C_L = 5 pF, R_L = 280 Ω, See Note 2		5.5	8.5	ns
t_{PLZ}					9	14	
t_{PHZ}	$\overline{G}$	W			5.5	8.5	ns
t_{PLZ}					9	14	

† t_{PLH} = Propagation delay time, low-to-high-level output
t_{PHL} = Propagation delay time, high-to-low-level output
t_{PZH} = Output enable time to high level
t_{PZL} = Output enable time to low level
t_{PHZ} = Output disable time from high level
t_{PLZ} = Output disable time from low level

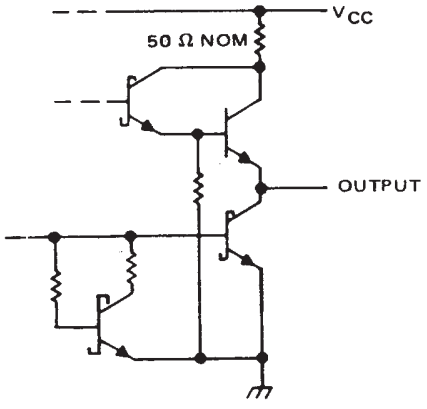
NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs

EQUIVALENT OF EACH INPUT



TYPICAL OF BOTH OUTPUTS



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