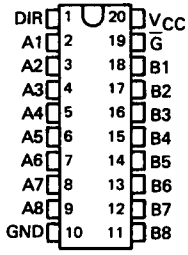
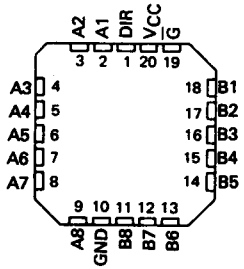
D2636, JANUARY 1981—REVISED MARCH 1988

- **Bidirectional Bus Transceivers in High-Density 20-Pin Packages**
- **Hysteresis at Bus Inputs Improves Noise Margins**
- **Choice of True or Inverting Logic**
- **A Bus Outputs are Open-Collector, B Bus Outputs are 3-State**

SN54LS638, SN54LS639 . . . J PACKAGE
SN74LS638, SN74LS639 . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS638, SN54LS639 . . . FK PACKAGE
(TOP VIEW)



description

These octal bus transceivers are designed for asynchronous two-way communication between open-collector and 3-state buses. The devices transmit data from the A bus (open-collector) to the B bus (3-state) or from the B bus to the A bus depending upon the level at the direction control (DIR) input. The enable input ($\overline{G}$) can be used to disable the device so the buses are isolated.

FUNCTION TABLE

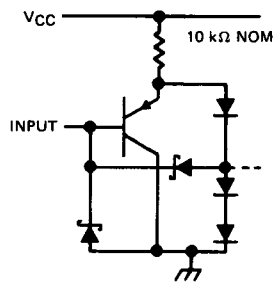
CONTROL INPUTS		OPERATION	
$\overline{G}$	DIR	'LS638	'LS639
L	L	$\overline{B}$ data to A bus	B data to A bus
L	H	$\overline{A}$ data to B bus	A data to B bus
H	X	Isolation	Isolation

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

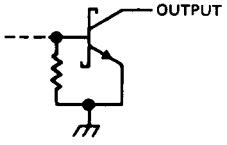
DEVICE	A OUTPUT	B OUTPUT	LOGIC
'LS638	Open-Collector	3-State	Inverting
'LS639	Open-Collector	3-State	True

schematics of inputs and outputs

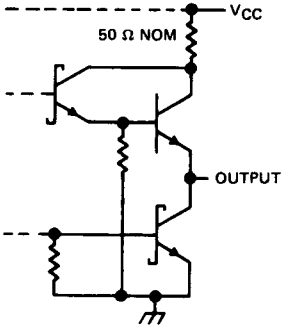
EQUIVALENT OF EACH INPUT



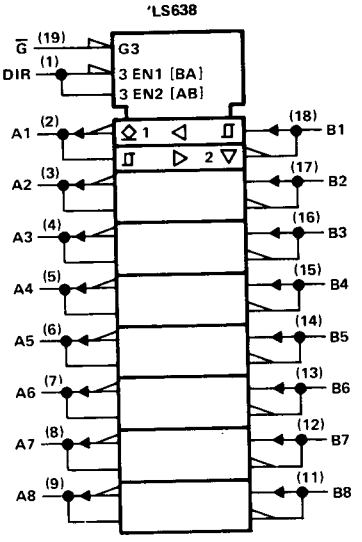
TYPICAL OF A OUTPUTS

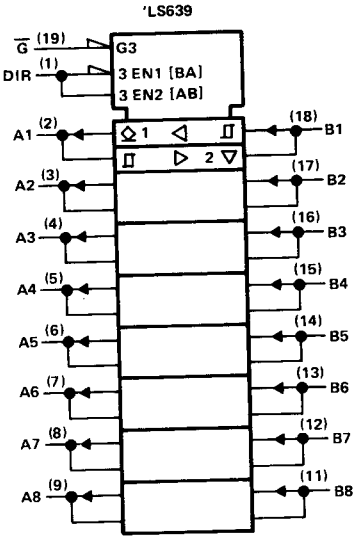


TYPICAL OF B OUTPUTS



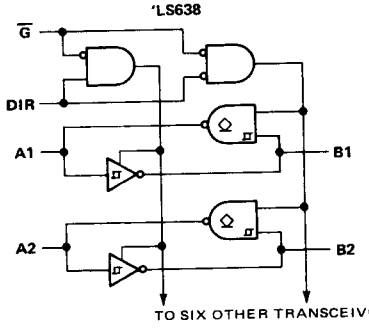
logic symbols†

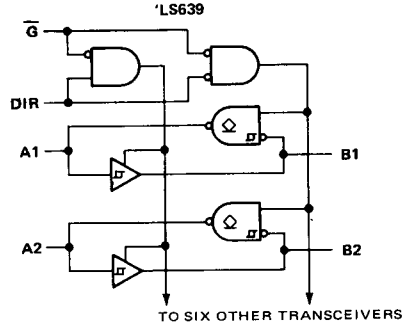




† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for DW, J, and N packages.

logic diagrams (positive logic)





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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage (DIR or $\overline{G}$)	7 V
Off-state output voltage (A or B)	5.5 V
Operating free-air temperature range: SN54LS638, SN54LS639	−55°C to 125°C
SN74LS638, SN74LS639	0°C to 70°C
Storage temperature range	−65°C to 150°C

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

TEXAS INSTRUMENTS
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recommended operating conditions

	SN54LS'			SN74LS'			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 voltage, V_{OH} (A bus)			5.5			5.5	V
High-level output current, I_{OH} (B bus)			−12			−15	mA
Low-level output current, I_{OL} (A or B bus)			12			24	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†		SN54LS'			SN74LS'			UNIT
					MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage				2			2			V
V_{IL}	Low-level input voltage						0.5			0.6	V
V_{IK}	Input clamp voltage		V_{CC} = MIN, I_I = −18 mA				−1.5			−1.5	V
	Hysteresis ($V_{T+}-V_{T-}$)		V_{CC} = MIN		0.1	0.4		0.2	0.4		V
I_{OH}	High-level output current	A	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX, V_{OH} = 5.5 V				0.1			0.1	mA
V_{OH}	High-level output voltage	B	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	I_{OH} = −3 mA	2.4			2.4			V
				I_{OH} = MAX	2			2			
V_{OL}	Low-level output voltage	A or B	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	I_{OL} = 12 mA		0.25	0.4		0.25	0.4	V
				I_{OL} = 24 mA					0.35	0.5	
I_{OZH}	Off-state output current, high-level voltage applied	B	V_{CC} = MAX, $\overline{G}$ at 2 V,	V_O = 2.7 V			20			20	μA
I_{OZL}	Off-state output current low-level voltage applied	A or B	V_{CC} = MAX, $\overline{G}$ at 2 V,	V_O = 0.4 V			−0.4			−0.4	mA
I_I	Input current at maximum input voltage	A or B	V_{CC} = MAX	V_I = 5.5 V			0.1			0.1	mA
		DIR or $\overline{G}$		V_I = 7 V			0.1			0.1	
I_{IH}	High-level input current		V_{CC} = MAX, V_I = 2.7 V				20			20	μA
I_{IL}	Low-level input current		V_{CC} = MAX, V_I = 0.4 V				−0.4			−0.4	mA
I_{OS}	Short-circuit output current§	B	V_{CC} = MAX		−40		−225	−40		−225	mA
I_{CCH}	Supply current, outputs high		V_{CC} = MAX, Outputs open			48	70		48	70	mA
I_{CCL}	Supply current, outputs low		V_{CC} = MAX, Outputs open			62	90		62	90	mA
I_{CCZ}	Supply current, outputs off		V_{CC} = MAX, Outputs open			64	95		64	95	mA

† 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.
§ 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, see note 2

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS638			'LS639			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	A	B	C_L = 45 pF, R_L = 667 Ω		6	10		8	15	ns
	B	A			17	25		19	25	
t_{PHL}	A	B			8	15		11	15	ns
	B	A			14	25		16	25	
t_{PLH}	$\overline{G}$	A			26	40		23	40	ns
t_{PHL}	$\overline{G}$	A			43	60		34	50	ns
t_{PZH}	$\overline{G}$	B			23	40		26	40	ns
t_{PZL}	$\overline{G}$	B			31	40		31	40	ns
t_{PHZ}	$\overline{G}$	B	C_L = 5 pF, R_L = 667 Ω		15	25		15	25	ns
t_{PLZ}	$\overline{G}$	B			15	25		15	25	ns

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