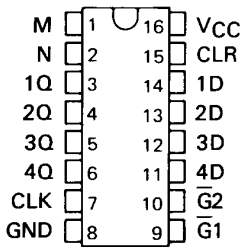
OCTOBER 1976—REVISED MARCH 1988

- 3-State Outputs Interface Directly with System Bus
- Gated Output-Control Lines for Enabling or Disabling the Outputs
- Fully Independent Clock Virtually Eliminates Restrictions for Operating in One of of Two Modes:

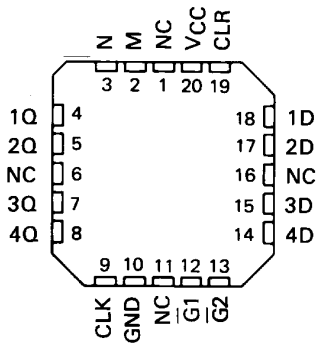
  Parallel Load
  Do Nothing (Hold)

- For application as Bus Buffer Registers

SN54173, SN54LS173A . . . J OR W PACKAGE
SN74173 . . . N PACKAGE
SN74LS173A . . . D OR N PACKAGE
(TOP VIEW)



SN54LS173A . . . FK PACKAGE
(TOP VIEW)



NC - No internal connection

TYPE	TYPICAL PROPAGATION DELAY TIME	MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
'173	23 ns	35 MHz	250 mW
'LS173A	18 ns	50 MHz	95 mW

description

The '173 and 'LS173A four-bit registers include D-type flip-flops featuring totem-pole three-state outputs capable of driving highly capacitive or relatively low-impedance loads. The high-impedance third state and increased high-logic-level drive provide these flip-flops with the capability of being connected directly to and driving the bus lines in a bus-organized system without need for interface or pull-up components. Up to 128 of the SN74173 or SN74LS173A outputs may be connected to a common bus and still drive two Series 54/74 or 54LS/74LS TTL normalized loads, respectively. Similarly, up to 49 of the SN54173 or SN54LS173A outputs can be connected to a common bus and drive one additional Series 54/74 or 54LS/74LS TTL normalized load, respectively. 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 times are shorter than the average output enable times.

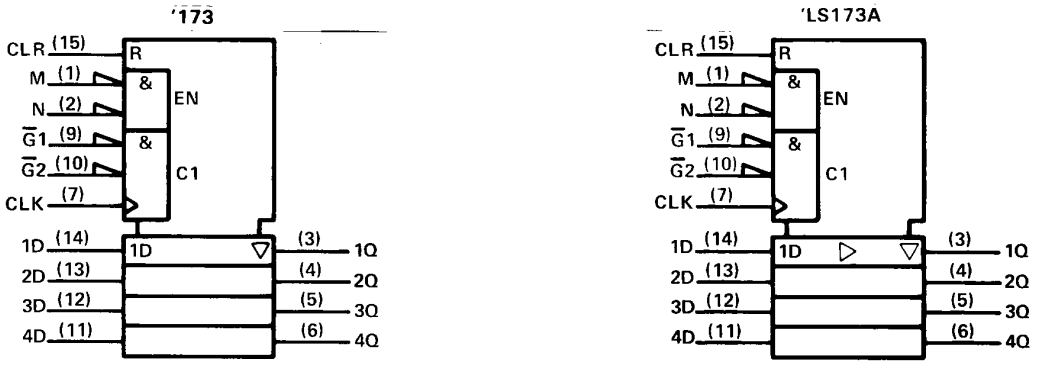
FUNCTION TABLE

INPUTS					OUTPUT
CLEAR	CLOCK	DATA ENABLE $\overline{G1}$	DATA ENABLE $\overline{G2}$	DATA D	Q
H	X	X	X	X	L
L	L	X	X	X	Q_0
L	↑	H	X	X	Q_0
L	↑	X	H	X	Q_0
L	↑	L	L	L	L
L	↑	L	L	H	H

When either M or N (or both) is (are) high the output is disabled to the high-impedance state; however sequential operation of the flip-flops is not affected.

Gated enable inputs are provided on these devices for controlling the entry of data into the flip-flops. When both data-enable inputs are low, data at the D inputs are loaded into their respective flip-flops on the next positive transition of the buffered clock input. Gate output control inputs are also provided. When both are low, the normal logic states (high or low levels) of the four outputs are available for driving the loads or bus lines. The outputs are disabled independently from the level of the clock by a high logic level at either output control input. The outputs then present a high impedance and neither load nor drive the bus line. Detailed operation is given in the function table.

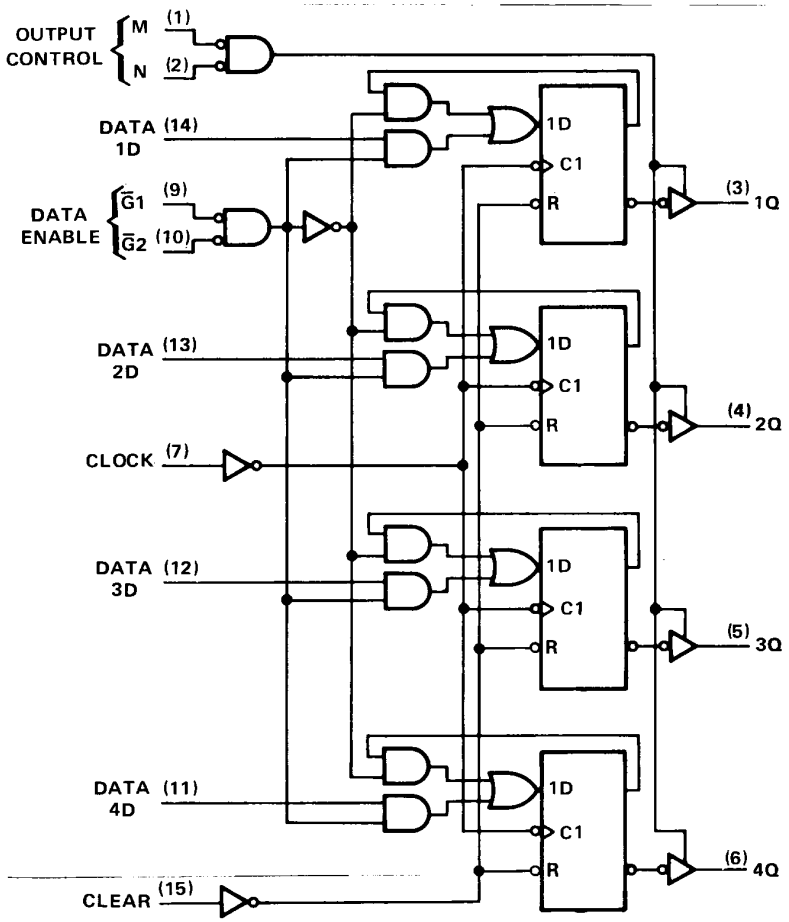
logic symbols†



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

2 TTL Devices

logic diagram (positive logic)



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

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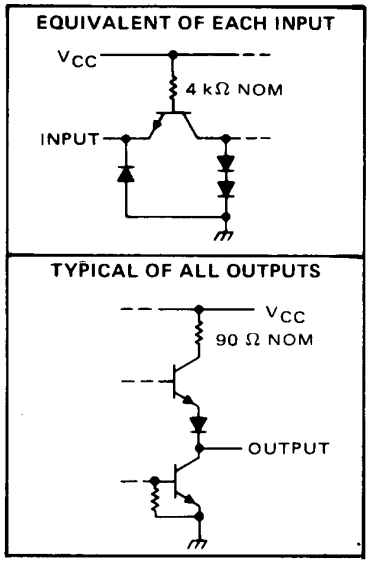
absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)		7 V
Input voltage: '173		5.5 V
'LS173A		7 V
Off-state output voltage		5.5 V
Operating free-air temperature range:	SN54173, SN54LS173A	−55°C to 125°C
	SN74173, SN74LS173A	0°C to 70°C
Storage temperature range		−65°C to 150°C

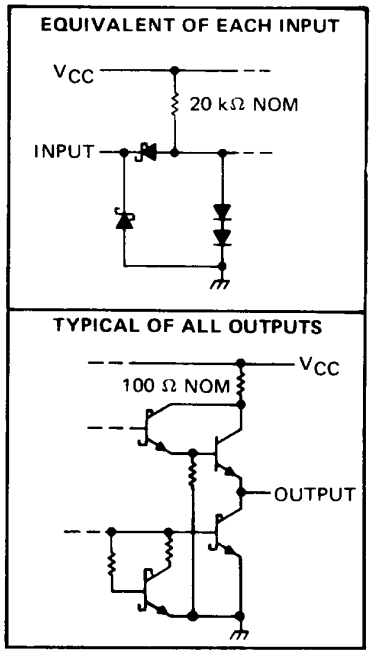
NOTE 1: Voltage values are with respect to network ground terminals.

schematics of inputs and outputs

'173



'LS173A



recommended operating conditions

		SN54173			SN74173			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
Input clock frequency, f_{clock}		0		25	0		25	MHz
Width of clock or clear pulse, t_w		20			20			ns
Setup time, t_{su}	Data enable	17			17			ns
	Data	10			10			
	Clear inactive state	10			10			
Hold time, t_h	Data enable	2			2			ns
	Data	10			10			
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			V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V,	I_{OL} = 16 mA			0.4	V
$I_{O(off)}$	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	
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		−30		−70	mA
I_{CC}	Supply current	V_{CC} = MAX,	See Note 2		50	72	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.
NOTE 2: I_{CC} is measured with all outputs open; clear grounded following momentary connection to 4.5 V; N, G1, G2, and all data inputs grounded; and the clock input and M at 4.5 V.

switching characteristics, V_{CC} = 5 V, T_A = 25°C, R_L = 400 Ω

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Maximum clock frequency	C_L = 50 pF, See Note 3	25	35		MHz
t_{PHL}	Propagation delay time, high-to-low-level output from clear input			18	27	ns
t_{PLH}	Propagation delay time, low-to-high-level output from clock input			28	43	ns
t_{PHL}	Propagation delay time, high-to-low-level output from clock input			19	31	
t_{PZH}	Output enable time to high level		7	16	30	ns
t_{PZL}	Output enable time to low level		7	21	30	
t_{PHZ}	Output disable time from high level	C_L = 5 pF, See Note 3	3	5	14	ns
t_{PLZ}	Output disable time from low level		3	11	20	

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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recommended operating conditions

		SN54LS173A			SN74LS173A			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}				−1			−2.6	mA
Low-level output current, I_{OL}				12			24	mA
Input clock frequency, f_{clock}		0		30	0		30	MHz
Width of clock or clear pulse, t_w		25			25			ns
Setup time, t_{su}	Data enable	35			35			ns
	Data	17			17			
	Clear inactive state	10			10			
Hold time, t_h	Data enable	0			0			ns
	Data	3			3			
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†		SN54LS173A			SN74LS173A			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			V
V_{IL}	Low-level input voltage					0.7			0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN,	I_I = −18 mA			−1.5			−1.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IL} = V_{IL}max	V_{IH} = 2 V, I_{OH} = MAX	2.4	3.4		2.4	3.1		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IL} = 0.8 V	I_{OL} = 12 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 24 mA					0.35	0.5	
$I_{O(off)}$	Off-state (high-impedance state) output current	V_{CC} = MAX, V_{IH} = 2 V	V_O = 2.7 V			20			20	μA
			V_O = 0.4 V			−20			−20	
I_I	Input current at maximum input voltage	V_{CC} = MAX,	V_I = 7 V			0.1			0.1	mA
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§	V_{CC} = MAX		−30		−130	−30		−130	mA
I_{CC}	Supply current	V_{CC} = MAX,	See Note 2		19	30		19	24	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.
NOTE 2: I_{CC} is measured with all outputs open; clear grounded following momentary connection to 4.5 V; N, G1, G2, and all data inputs grounded; and the clock input and M at 4.5 V.

switching characteristics, V_{CC} = 5 V, T_A = 25°C, R_L = 667 Ω

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Maximum clock frequency	C_L = 45 pF, See Note 3	30	50		MHz
t_{PHL}	Propagation delay time, high-to-low-level output from clear input			26	35	ns
t_{PLH}	Propagation delay time, low-to-high-level output from clock input			17	25	ns
t_{PHL}	Propagation delay time, high-to-low-level output from clock input			22	30	
t_{PZH}	Output enable time to high level			15	23	ns
t_{PZL}	Output enable time to low level			18	27	
t_{PHZ}	Output disable time from high level	C_L = 5 pF, See Note 3		11	20	ns
t_{PLZ}	Output disable time from low level			11	17	

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

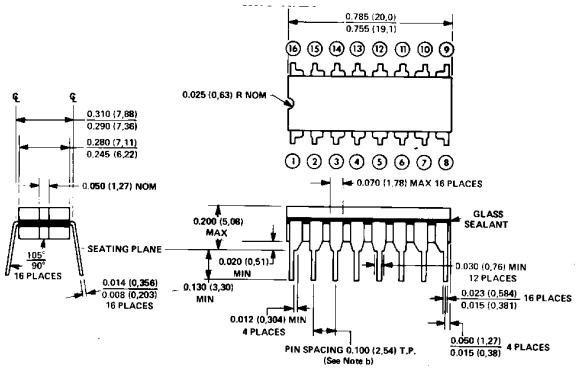
TYPES SN54LS173A, SN74LS173A
4-BIT D-TYPE REGISTERS WITH 3-STATE OUTPUTS

ORDERING INSTRUCTIONS AND MECHANICAL DATA

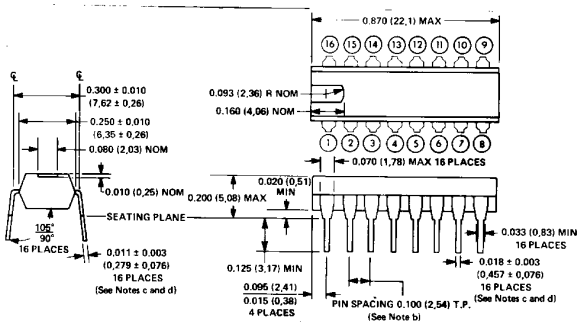
The SN54LS173A and SN74LS173A circuits are available in the ceramic dual-in-line package (outline J), in the plastic dual-in-line package (outline N), and in the ceramic flat package (outline W). Orders for these circuits should include the package outline letter (J, N, or W) at the end of the circuit type number. Also, complete the type number with the appropriate suffix number: –00 for tin-plated (bright-dipped) leads on the J and W packages and silver-plated leads on the N package, or –10 for solder-dipped leads (at additional cost) on all packages.

Examples: SN54LS173AJ-10, SN74LS173AN-00

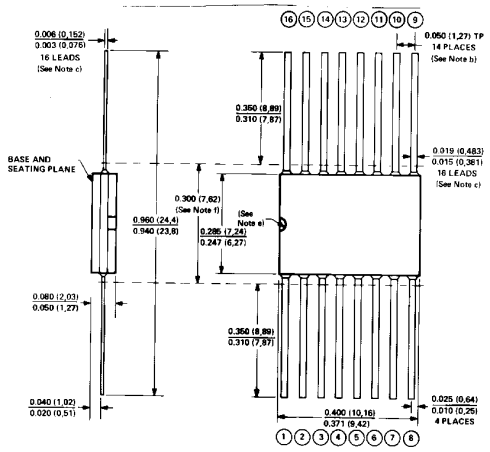
16-PIN J CERAMIC DUAL-IN-LINE OUTLINE



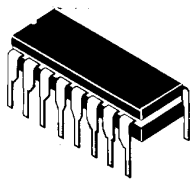
16-PIN N PLASTIC DUAL-IN-LINE PACKAGE OUTLINE



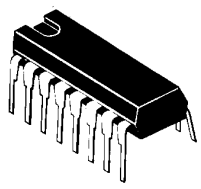
16-PIN W CERAMIC FLAT PACKAGE OUTLINE



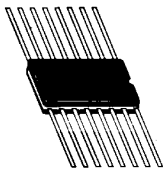
Falls Within JEDEC MO-004AG Dimensions



J PACKAGE



N PACKAGE



W PACKAGE

NOTES: a. All linear dimensions are in inches and parenthetically in millimeters. Inch dimensions govern.
b. Each lead is located within 0.010 (0,26) of its true longitudinal position on the J and N packages, or within 0.005 (0,13) radius of true position (T.P.) at maximum material condition on the W package.
c. This dimension does not apply for solder-dipped leads.
d. When solder-dipped leads are specified, dipped area extends from lead tip to at least 0.020 (0,50) above the seating plane on the J and N packages, or to within 0.050 (1,27) of the package body on the W package.
e. Index point is provided for terminal identification only.
f. This dimension determines a zone within which all body and lead irregularities lie.

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