

TYPES SN54LS381A, SN54LS382, SN54S381, SN74LS381A, SN74LS382, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

D2430, JANUARY 1981 - REVISED DECEMBER 1983

PIN DESIGNATIONS

DESIGNATION	PIN NOS.	FUNCTION
A3, A2, A1, A0	17, 19, 1, 3	WORD A INPUTS
B3, B2, B1, B0	16, 18, 2, 4	WORD B INPUTS
S2, S1, S0	7, 6, 5	FUNCTION-SELECT INPUTS
C_n	15	CARRY INPUT FOR ADDITION, INVERTED CARRY INPUT FOR SUBTRACTION
F3, F2, F1, F0	12, 11, 9, 8	FUNCTION OUTPUTS
\bar{P} ('LS381A 'S381 ONLY)	14	ACTIVE-LOW CARRY PROPAGATE OUTPUT
\bar{G} ('LS381A 'S381 ONLY)	13	ACTIVE-LOW CARRY GENERATE OUTPUT
$C_n + 4$ ('LS382 ONLY)	14	RIPPLE-CARRY OUTPUT
OVR ('LS382 ONLY)	13	OVERFLOW OUTPUT
V _{CC}	20	SUPPLY VOLTAGE
GND	10	GROUND

- Fully Parallel 4-Bit ALU's in 20-Pin Package for 0.300-Inch Row Spacing
- Ideally Suited for High-Density Economical Processors
- 'LS381A and 'S381 Feature \bar{G} and \bar{P} Outputs for Look-Ahead Carry Cascading
- 'LS382 Features Ripple Carry ($C_n + 4$) and Overflow (OVR) Outputs
- Arithmetic and Logic Operations Selected Specifically to Simplify System Implementation:
 - A Minus B
 - B Minus A
 - A Plus B
 - and Five Other Functions

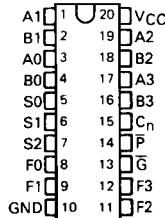
description

The 'LS381A, 'S381 and 'LS382 are low-power Schottky and Schottky TTL arithmetic logic units (ALUs)/function generators that perform eight binary arithmetic/logic operations on two 4-bit words as shown in the function table. The exclusive-OR, AND, or OR function of the two Boolean variables is provided without the use of external circuitry. Also, the outputs can be cleared (low) or preset (high) as desired. The 'LS381A and 'S381 provide two cascade outputs (\bar{P} and \bar{G}) for expansion utilizing SN54S182/SN74S182 look-ahead carry generators. The 'LS382 provides a $C_n + 4$ output to ripple the carry to the C_n input of the next stage. The 'LS382 detects and indicates two's complement overflow condition via the OVR output. The overflow output is logically equivalent to $C_n + 3 \oplus C_n + 4$. When the 'LS382 is cascaded to handle word lengths longer than four bits in length, only the most significant overflow (OVR) output is used.

The SN54' Family is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74' family is characterized for operation from 0°C to 70°C .

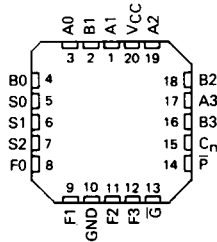
SN54LS381A, SN54S381
... J PACKAGE
SN74LS381A, SN74S381
... DW, J OR N PACKAGE

(TOP VIEW)



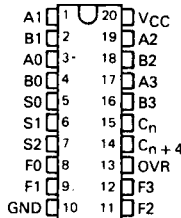
SN54LS381A, SN54S381
... FK PACKAGE
SN74LS381A, SN74S381
... FN PACKAGE

(TOP VIEW)



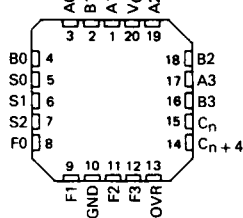
SN54LS382 ... J PACKAGE
SN74LS382 ...
DW, J OR N PACKAGE

(TOP VIEW)



SN54LS382 ... FK PACKAGE
SN74LS382 ... FN PACKAGE

(TOP VIEW)



FUNCTION TABLE

SELECTION	ARITHMETIC/LOGIC OPERATION		
S2	S1	S0	OPERATION
L	L	L	CLEAR
L	L	H	B MINUS A
L	H	L	A MINUS B
L	H	H	A PLUS B
H	L	L	$A \oplus B$
H	L	H	$A + B$
H	H	L	AB
H	H	H	PRESET

H = high level, L = low level

PRODUCTION DATA

This document contains information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS
INSTRUMENTS

POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

3-1037

3

TTL DEVICES

TYPES SN54LS381A, SN54LS382, SN54S381, SN74LS381A, SN74LS382, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTIONS GENERATORS

function table

Certain differences exist in the \bar{G} , \bar{P} ('LS381A, 'S381) and OVR, $C_n + 4$ ('LS382) function table compared with similar parts from other vendors. No differences exist in the arithmetic modes (B minus A, A minus B, and A plus B), where these outputs perform valuable cascade functions.

There are slight differences in the other modes (CLEAR, $A + B$, $A \oplus B$, AB, and PRESET), where these outputs are strictly "don't care."

This function table is a condensed version and assumes for A_n that A0, A1, A2, and A3 inputs all agree and for B_n that B0, B1, B2, and B3 inputs all agree. This table is intended to point out the response of these \bar{G} , \bar{P} ('LS381A, 'S381) and OVR, $C_n + 4$ ('LS382) outputs in all modes of operation to facilitate incoming inspection.

FUNCTION TABLE

ARITHMETIC/LOGIC OPERATION	INPUTS						OUTPUTS				('LS381A, 'S381)		('LS382)		
	S2	S1	S0	C_n	A_n	B_n	F3	F2	F1	F0	\bar{G}	\bar{P}	OVR	$C_n + 4$	
CLEAR	L	L	L	X	X	X	L	L	L	L	H	H	H	L	
B MINUS A	L	L	H	L	L	L	H	H	H	H	H	L	L	L	
				L	L	H	H	H	H	L	L	H	L	H	
				L	H	L	L	L	L	L	L	H	H	L	L
				L	H	H	H	H	H	H	H	H	H	L	L
				H	L	L	L	L	L	L	L	L	H	L	L
				H	L	H	H	H	H	H	H	L	H	L	H
				H	H	L	L	L	L	L	H	H	H	L	L
				H	H	H	L	L	L	L	L	L	H	L	L
A MINUS B	L	H	L	L	L	L	H	H	H	H	H	L	L	L	
				L	L	H	L	L	L	L	H	H	L	L	
				L	H	L	H	H	H	L	L	H	L	L	
				L	H	H	H	H	H	H	H	H	L	L	
				H	L	L	L	L	L	L	L	H	L	L	
				H	L	H	L	L	L	H	H	H	L	L	
				H	H	L	H	H	H	H	L	H	L	H	
				H	H	H	L	L	L	L	L	H	L	L	
A PLUS B	L	H	H	L	L	L	L	L	L	L	H	H	L	L	
				L	L	H	H	H	H	H	H	L	L		
				L	H	L	H	H	H	H	H	H	L	L	
				L	H	H	H	H	H	L	L	H	H	L	
				H	L	L	L	L	L	L	H	H	L	L	
				H	L	H	L	L	L	L	L	H	L	L	
				H	H	L	L	L	L	L	L	H	L	L	
				H	H	H	H	H	H	H	H	H	L	L	
$A \oplus B$	H	L	L	X	L	L	L	L	L	L	H	H	L	L	
				L	L	H	H	H	H	H	H	L	L		
				H	L	H	H	H	H	H	H	L	H		
				L	H	L	H	H	H	H	H	L	L		
				H	H	L	H	H	H	H	H	L	H		
				X	H	H	L	L	L	L	L	H	L		
$A + B$	H	L	H	X	L	L	L	L	L	L	H	H	L	L	
				L	L	H	H	H	H	H	H	L	L		
				H	L	H	H	H	H	H	H	L	H		
				L	H	L	H	H	H	H	H	L	L		
				H	H	L	H	H	H	H	H	L	H		
				L	H	H	H	H	H	H	H	L	L		
AB	H	H	L	X	L	L	L	L	L	L	H	H	L	L	
				X	L	H	L	L	L	L	H	L			
				X	H	L	L	L	L	L	H	L			
				L	H	H	H	H	H	H	H	L			
PRESET	H	H	H	L	X	X	H	H	H	H	L	L	L		
				H	X	X	H	H	H	H	H	L	L		

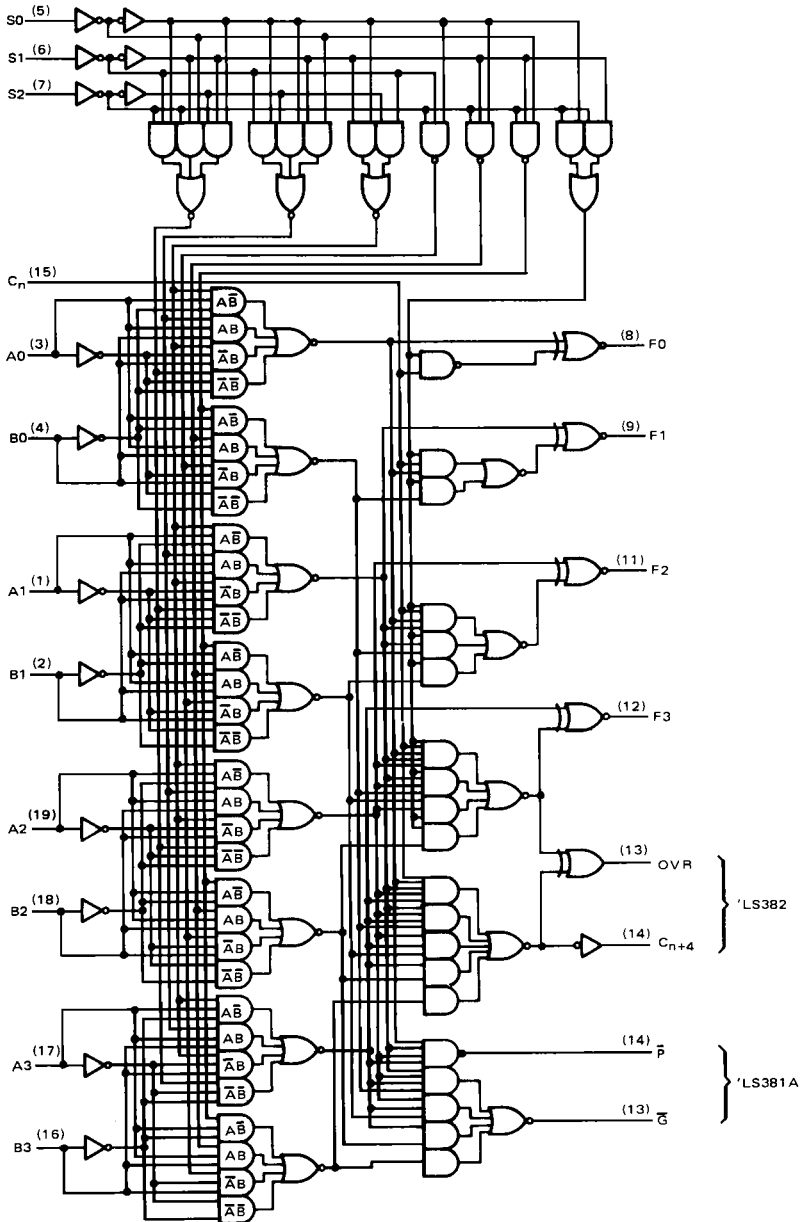
3

TTL DEVICES

TYPES SN54LS381A, SN54LS382, SN74LS381A, SN74LS382
ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

logic diagram (positive logic)

'LS381A, 'LS382

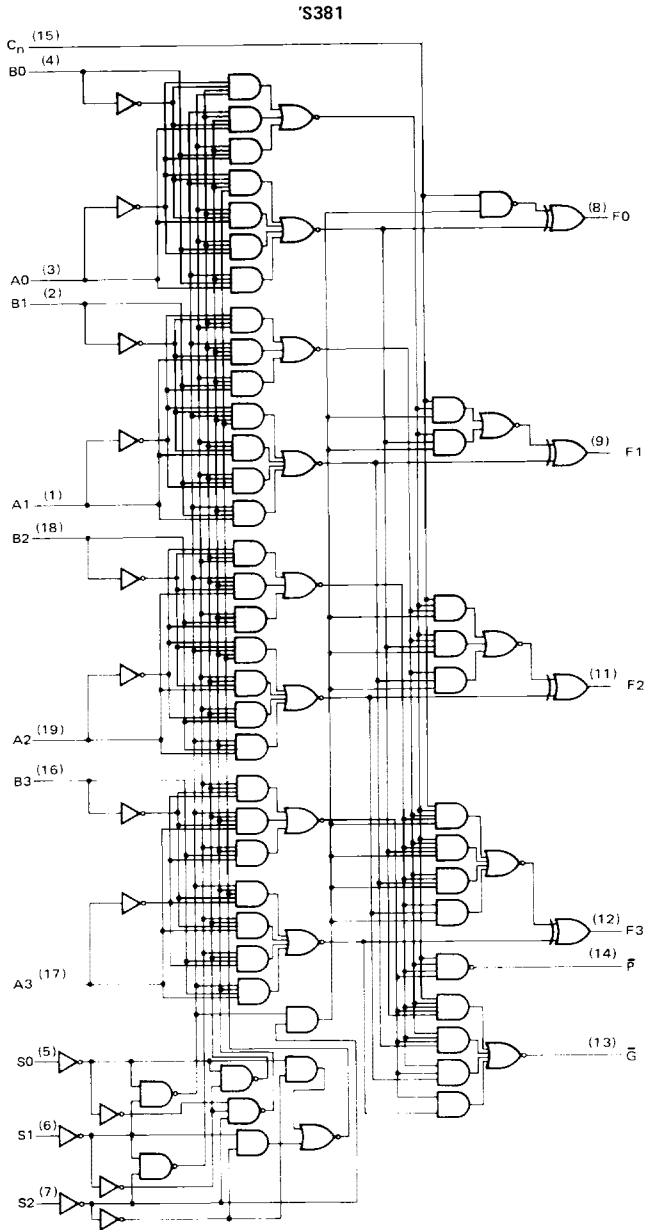


Pin numbers shown on logic notation are for DW, J or N packages.

3
TTL DEVICES

TYPES SN54S381, SN74S381
ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

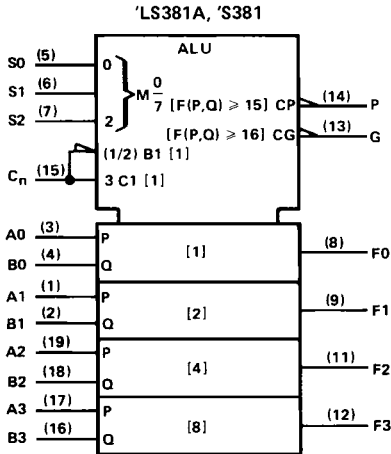
logic diagram and schematics of inputs and outputs



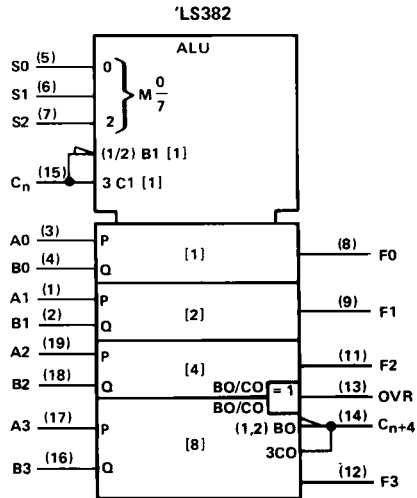
Pin numbers shown on logic notation are for DW, J or N packages.

TYPES SN54LS381A, SN54LS382, SN54S381, SN74LS381A, SN74LS382, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

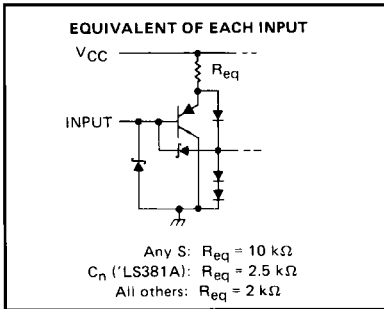
logic symbols



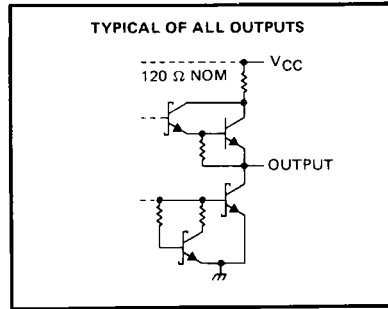
Pin numbers shown on logic notation are for DW, J or N packages.



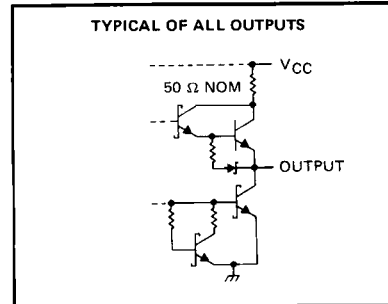
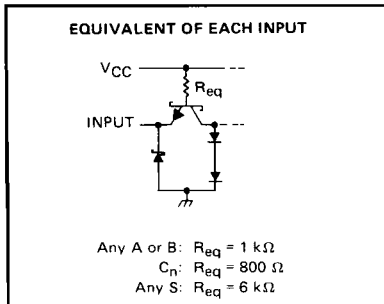
schematics of inputs and outputs



'LS381, 'LS382



'S381



3

TTL DEVICES

TYPES SN54LS381A, SN54LS382, SN74LS381A, SN74LS382

ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

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
Operating free-air temperature range: SN54LS381A, SN54LS382	-55°C to 125°C
SN74LS381A, SN74LS382	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.

recommended operating conditions

	SN54LS'			SN74LS'			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				0.8			V
I_{OH} High-level output current				-0.4			mA
I_{OL} Low-level output current	\bar{G} output of 'LS381A			16			mA
	All other outputs			8			
T_A Operating free-air temperature	-55			125			°C

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

PARAMETER	TEST CONDITIONS†	SN54LS'		SN74LS'		UNIT
		MIN	TYP‡	MAX	MIN	
V_{IK}	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$	-1.5		-1.5		V
V_{OH}	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}, I_{OH} = -0.4 \text{ mA}$	2.5	3.4	2.7	3.4	V
V_{OL}	\bar{G} ('LS381A)	0.47		0.47		V
	Other outputs	0.25		0.25		
I_I	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$	0.1		0.1		mA
		20		20		
I_{IH}	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$	100		100		μA
		80		80		
		100		100		
		100		100		
I_{IL}	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$	-0.2		-0.2		mA
		-1		-1		
		-0.8		-0.8		
		-0.8		-0.8		
$I_{OS}§$	$V_{CC} = \text{MAX}$	-20	-100	-20	-100	mA
I_{CC}	$V_{CC} = \text{MAX},$ All inputs grounded, outputs open	35	65	35	65	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

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

TYPES SN54LS381A, SN54LS382, SN74LS381A, SN74LS382 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS381A			'LS382			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	C_n	Any F	$R_L = 2\text{ k}\Omega, \quad C_L = 15\text{ pF}$	18		27	18		27	ns
t_{PHL}				14		21	14		21	
t_{PLH}	Any A or B	\bar{G}		20		30				ns
t_{PHL}				21		33				
t_{PLH}	Any A or B	\bar{P}		21		33				ns
t_{PHL}				23		33				
t_{PLH}	A_i or B_i	F_i		20		30	20		30	ns
t_{PHL}				15		23	15		23	
t_{PLH}	S0, S1, S2	F_i		35		53	35		53	ns
t_{PHL}				34		51	34		51	
t_{PLH}	S0, S1, S2	\bar{G} or \bar{P}		31		47				ns
t_{PHL}				32		48				
t_{PLH}	Any A or B	C_{n+4}					28		42	ns
t_{PHL}								26		
t_{PLH}	Any A or B	OVR					23		35	ns
t_{PHL}								27		
t_{PLH}	S0, S1, S2	C_{n+4} or OVR					38		57	ns
t_{PHL}								36		
t_{PLH}	C_n	OVR					10		15	ns
t_{PHL}								13		
t_{PLH}	C_n	C_{n+4}				13		21	ns	
t_{PHL}							11			20

NOTE 3: See General Information Section for load circuits and voltage waveforms.

3

TTL DEVICES

TYPES SN54S381, SN74S381

ARITHMETIC LOGIC UNIT/FUNCTION GENERATORS

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
Interemitter voltage (see Note 2)	5.5 V
Operating free-air temperature range: SN54S381	-55°C to 125°C
SN74S381	0°C to 70°C
Storage free-air temperature range	-65°C to 150°C

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. For this circuit, this rating applies to each A input in conjunction with its respective B input; for example A0 with B0, etc.

recommended operating conditions

	SN54S381			SN74S381			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			-1	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	$V_{CC} = \text{MIN}$, $I_I = -18 \text{ mA}$			-1.2	V
V_{OH}	High-level output voltage	SN54S381 $V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$,	2.4	3.4		V
		SN74S381 $V_{IL} = 0.8 \text{ V}$, $I_{OH} = -1 \text{ mA}$	2.7	3.4		
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = 0.8 \text{ V}$, $I_{OL} = 20 \text{ mA}$			0.5	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$			1	mA
I_{IH}	High-level input current	Any S input			50	μA
		C_n	$V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$		250	
		All others			200	
I_{IL}	Low-level input current	Any S input	$V_{CC} = \text{MAX}$, $V_I = 0.5 \text{ V}$		-2	mA
		C_n			-8	
		All others			-6	
I_{OS}	Short-circuit output current§	$V_{CC} = \text{MAX}$	-40		-100	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$		105	160	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

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

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

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	C_n	Any F	$C_L = 15 \text{ pF}$, $R_L = 280 \Omega$, See Note 3	10	17	ns	
t_{PHL}				10	17		
t_{PLH}	Any A or B	\bar{G}		12	20	ns	
t_{PHL}				12	20		
t_{PLH}	Any A or B	\bar{P}		11	18	ns	
t_{PHL}				11	18		
t_{PLH}	A_i or B_i	F_i		18	27	ns	
t_{PHL}				16	25		
t_{PLH}	Any S	Any		18	30	ns	
t_{PHL}				18	30		

¶ t_{PLH} = propagation delay time, low-to-high-level output

¶ t_{PHL} = propagation delay time, high-to-low-level output

NOTE 3: See General Information Section for load circuits and voltage waveforms.