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Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceed the OCM data sheet.

### **Quality Overview**

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
  - Class Q Military
  - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
  - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

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The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

# SN54LS381A, SN54S381, SN74LS381A, SN54LS382A, SN74LS382A, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

D2430, JANUARY 1981 — REVISED MARCH 1988

## 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 <sub>n</sub>	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 <sub>n</sub> + 4 ('LS382A ONLY)	14	RIPPLE-CARRY OUTPUT
OVR ('LS382A ONLY)	13	OVERFLOW OUTPUT
V <sub>CC</sub>	20	SUPPLY VOLTAGE
GND	10	GROUND

- Fully Parallel 4-Bit ALUs 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
- 'LS382A Features Ripple Carry (C<sub>n</sub> + 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

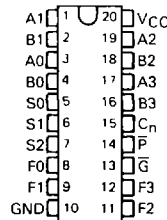
## description

The 'LS381A, 'S381 and 'LS382A 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<sub>n</sub> + 4 output to ripple the carry to the C<sub>n</sub> input of the next stage. The 'LS382A detects and indicates two's complement overflow condition via the OVR output. The overflow output is logically equivalent to C<sub>n</sub> + 3 ⊕ C<sub>n</sub> + 4. When the 'LS382A 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.

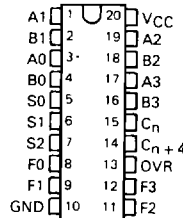
SN54LS381A, SN54S381  
... J OR W PACKAGE  
SN74LS381A, SN74S381  
... DW OR N PACKAGE

(TOP VIEW)



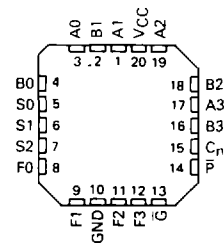
SN54LS382A ...  
J OR W PACKAGE  
SN74LS382A ...  
DW OR N PACKAGE

(TOP VIEW)

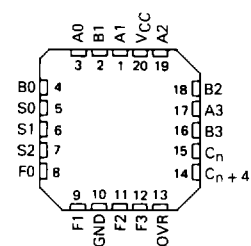


SN54LS381A, SN54S381  
... FK PACKAGE

(TOP VIEW)



SN54LS382A ... FK PACKAGE  
(TOP VIEW)



FUNCTION TABLE

SELECTION	ARITHMETIC/LOGIC		
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 ⊕ B		
H L H	A + B		
H H L	AB		
H H H	PRESET		

H = high level, L = low level

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PRODUCTION DATA documents contain 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.

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# SN54LS381A, SN54S381, SN74LS381A, SN54LS382A, SN74LS382A, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTIONS GENERATORS

## function table

Certain differences exist in the  $\bar{G}$ ,  $\bar{P}$  ('LS381A, 'S381) and OVR,  $C_{n+4}$  ('LS382A) function table compared with similar parts from other technologies and 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,  $C_{n+4}$  ('LS382A) outputs in all modes of operation to facilitate incoming inspection.

FUNCTION TABLE

ARITHMETIC/LOGIC OPERATION	INPUTS						OUTPUTS				'LS381A, 'S381		'LS382A)		
	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	L	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
				L	L	L	L	L	L	L	L	L	H	L	L
				L	L	H	H	H	H	H	H	L	H	L	H
				L	H	L	L	L	L	L	L	H	H	L	L
				L	H	H	L	L	L	L	L	H	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	L	H	H	L	H
				L	H	L	H	H	H	H	L	L	H	L	L
				L	H	H	H	H	H	H	H	H	H	L	L
				L	L	L	L	L	L	L	L	L	H	L	L
				L	L	H	L	L	L	L	L	H	H	L	L
				L	H	L	L	L	L	L	L	H	L	L	H
				L	H	H	L	L	L	L	L	H	L	L	H
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	
				L	H	L	H	H	H	H	H	H	L	L	
				L	H	H	H	H	H	L	L	L	H	L	
				L	L	L	L	L	L	L	L	H	H	L	
				L	L	H	L	L	L	L	L	H	L	L	
				L	H	L	L	L	L	L	L	H	L	L	
				L	H	H	L	L	L	L	L	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		
				L	L	L	H	H	H	H	H	H	L	H	
				L	H	L	H	H	H	H	H	H	L	L	
				L	H	L	H	H	H	H	H	H	L	H	
				L	H	H	L	L	L	L	L	H	L	L	
				L	H	L	L	L	L	L	L	H	L	L	
				L	H	H	L	L	L	L	L	H	L	L	
$A \cdot B$	H	L	H	X	L	L	L	L	L	L	H	H	L	L	
				L	L	H	H	H	H	H	H	L	L		
				L	L	L	H	H	H	H	H	L	L		
				L	H	L	H	H	H	H	H	L	L		
				L	H	L	H	H	H	H	H	L	L		
				L	H	H	H	H	H	H	H	L	L		
				L	H	L	H	H	H	H	H	L	L		
				L	H	H	L	L	L	L	L	H	L		
AB	H	H	L	X	L	L	L	L	L	L	H	H	L	L	
				L	L	H	L	L	L	L	H	L			
				L	L	L	L	L	L	L	L	H	L		
				L	H	L	L	L	L	L	L	H	L		
				L	H	H	H	H	H	H	H	L	L		
				L	H	L	L	L	L	L	L	H	L		
				L	H	H	L	L	L	L	L	H	L		
				L	H	H	L	L	L	L	L	H	L		
PRESET	H	H	H	L	X	X	H	H	H	H	H	L	L		
				H	X	X	H	H	H	H	H	L	H		

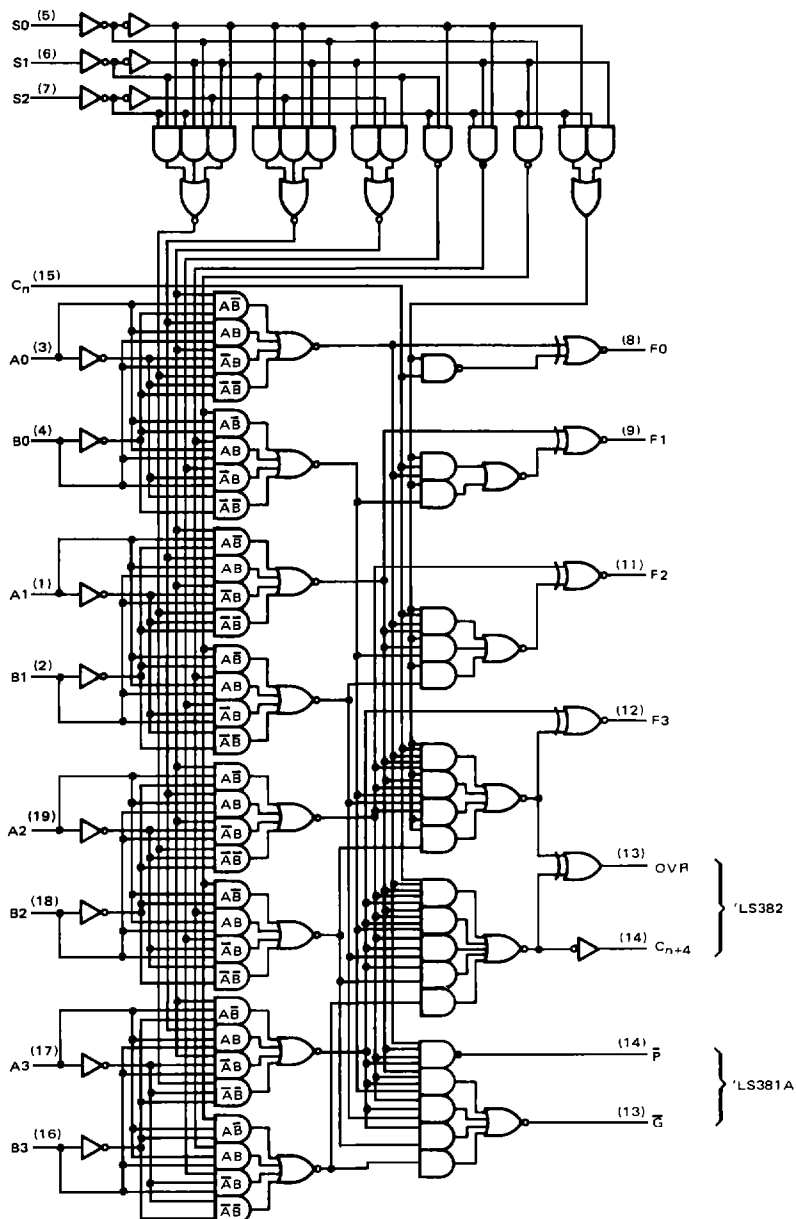
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SN54LS381A, SN54LS382A, SN74LS381A, SN74LS382A  
ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

logic diagram (positive logic)

1S381A, 1S382A



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

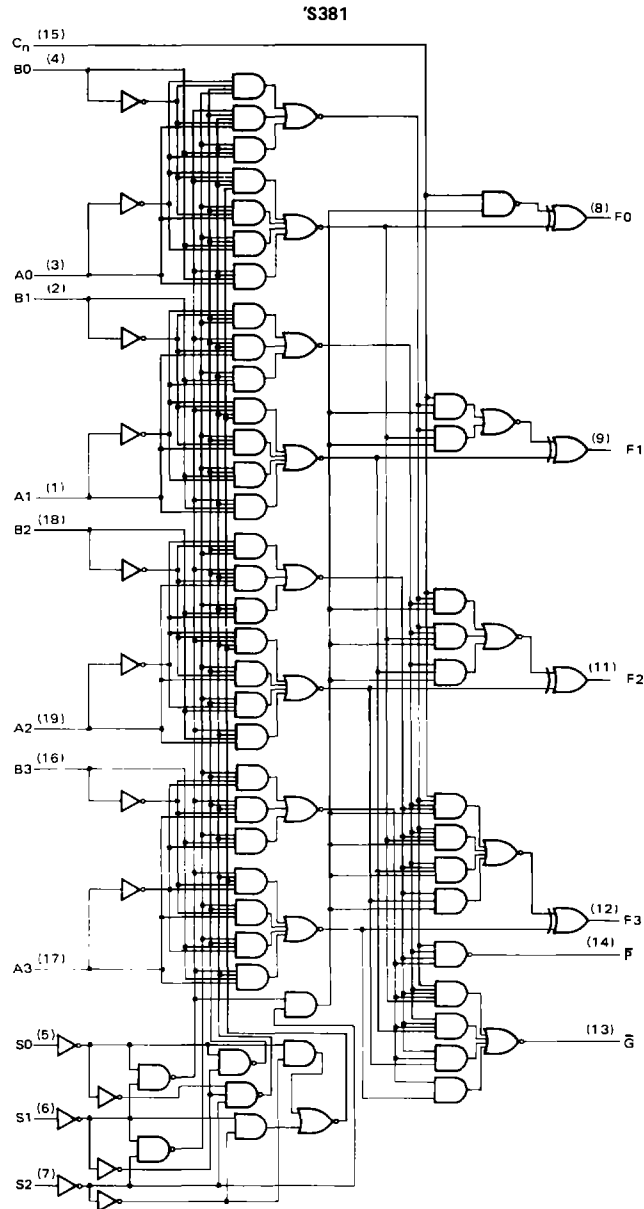
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**SN54S381, SN74S381**  
**ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS**

logic diagram and schematics of inputs and outputs

**2**

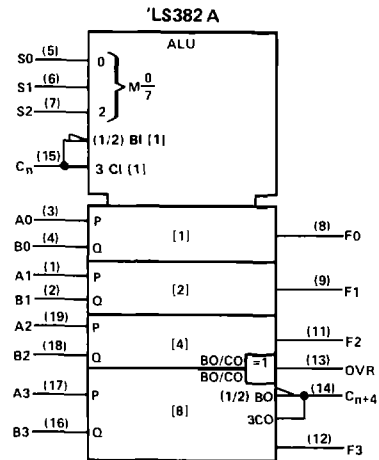
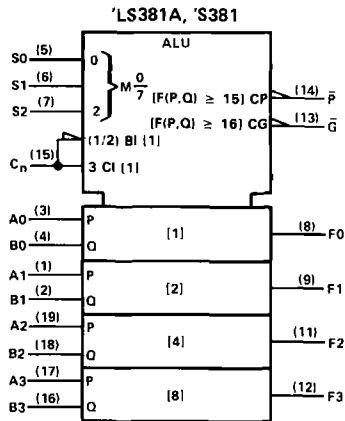
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Pin numbers shown are for DW, J, N, and W packages.

# SN54LS381A, SN54S381, SN74LS381A, SN54LS382A, SN74LS382A, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

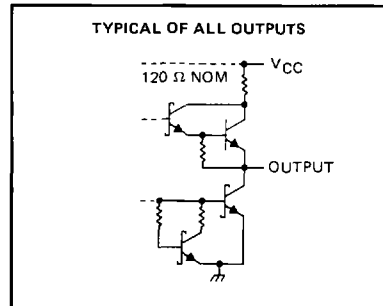
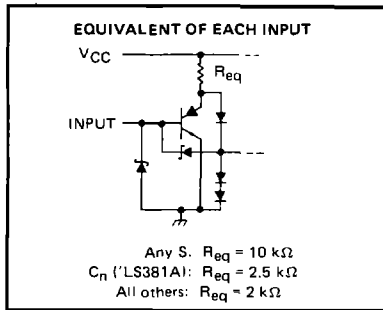
logic symbols†



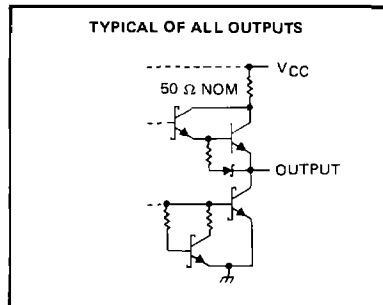
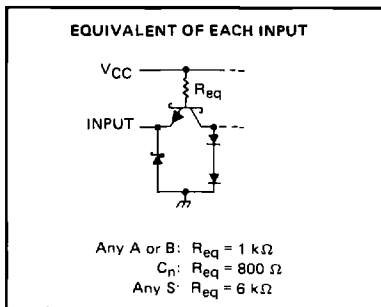
† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for DW, J, N, and W packages

## schematics of inputs and outputs



'S381



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# SN54LS381A, SN54LS382A, SN74LS381A, SN74LS382A

## 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, SN54LS382A	-55°C to 125°C
SN74LS381A, SN74LS382A	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				16			mA
				4			
$T_A$ Operating free-air temperature	-55			125			°C

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

PARAMETER	TEST CONDITIONS†	SN54LS'		SN74LS'		UNIT
		MIN	TYP‡	MIN	TYP‡	
$V_{IK}$	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$	-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		
		0.35		0.5		
$I_I$	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$	0.1		0.1		mA
$I_{IH}$	Any S	20		20		$\mu\text{A}$
	Any A or B	100		100		
	$C_n$ ('LS381A)	80		80		
	$C_n$ ('LS382A)	100		100		
$I_{IL}$	Any S	-0.2		-0.2		mA
	Any A or B	-1		-1		
	$C_n$ ('LS381A)	-0.8		-0.8		
	$C_n$ ('LS382A)	-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		35		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.

# SN54LS381A, SN54LS382A, SN74LS381A, SN74LS382A 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 <sub>PLH</sub>	C <sub>n</sub>	Any F	R <sub>L</sub> = 2 kΩ,      C <sub>L</sub> = 15 pF	18	27		18	27		ns
t <sub>PHL</sub>				14	21		14	21		
t <sub>PLH</sub>	Any A or B	$\bar{G}$		20	30					ns
t <sub>PHL</sub>				21	33					
t <sub>PLH</sub>	Any A or B	$\bar{P}$		21	33					ns
t <sub>PHL</sub>				23	33					
t <sub>PLH</sub>	A <sub>i</sub> or B <sub>i</sub>	F <sub>i</sub>		20	30		20	30		ns
t <sub>PHL</sub>				15	23		15	23		
t <sub>PLH</sub>	S0, S1, S2	F <sub>i</sub>		35	53		35	53		ns
t <sub>PHL</sub>				34	51		34	51		
t <sub>PLH</sub>	S0, S1, S2	$\bar{G}$ or $\bar{P}$		31	47					ns
t <sub>PHL</sub>				32	48					
t <sub>PLH</sub>	Any A or B	C <sub>n+4</sub>					28	42		ns
t <sub>PHL</sub>							26	39		
t <sub>PLH</sub>	Any A or B	OVR					23	35		ns
t <sub>PHL</sub>							27	41		
t <sub>PLH</sub>	S0, S1, S2	C <sub>n+4</sub> or OVR					38	57		ns
t <sub>PHL</sub>							36	54		
t <sub>PLH</sub>	C <sub>n</sub>	OVR					10	15		ns
t <sub>PHL</sub>							13	23		
t <sub>PLH</sub>	C <sub>n</sub>	C <sub>n+4</sub>				13	21		ns	
t <sub>PHL</sub>						11	20			

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

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# SN54S381, SN74S381

## 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	5.5 V
Intermitter 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 intermitter 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	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$		50	$\mu\text{A}$
		$C_n$			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		
$t_{PLH}$	$A_1$ or $B_1$	$F_1$		18	27	ns	
$t_{PHL}$				16	25		
$t_{PLH}$	Any S	Any		18	30	ns	
$t_{PHL}$				18	30		

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

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