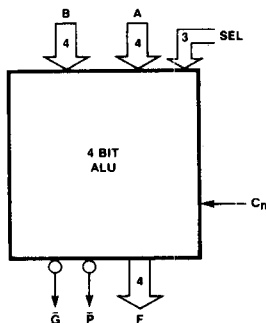# Arithmetic Logic Unit/ Function Generator

SN74S381

Features/Benefits

- A fully parallel 4-bit ALU
- Ideally suited for high-speed processors
- Generate and propagate outputs for full carry lookahead
- Three arithmetic functions
- Three logic functions
- Preset and clear functions

Ordering Information

PART NUMBER	PACKAGE	TEMPERATURE
SN74S381	N, J	Commercial

Pin Configuration

SN74S381

Description

The 'S381 is a Schottky TTL arithmetic logic unit (ALU)/function generator that performs eight binary arithmetic/logic operations on two 4-bit words as shown in the function table. These operations are selected by the three function-select lines (S0, S1, S2). A full lookahead carry circuit is provided for fast, simultaneous carry generation by means of two cascaded outputs (P and G) for the four bits in the package.
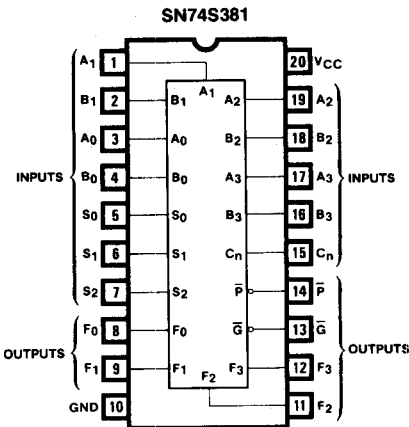
Logic Symbol

Function Table

SELECTION			ARITHMETIC/LOGIC OPERATION
S2	S1	S0	
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 ††

† Force all F outputs to be Lows.
†† Force all F outputs to be Highs.

TWX: 910-338-2376
2175 Mission College Blvd. Santa Clara, CA 95054-1592 Tel: (408) 970-9700 TWX: 910-338-2374

Monolithic Memories **MMI**

10-3

Logic Diagram
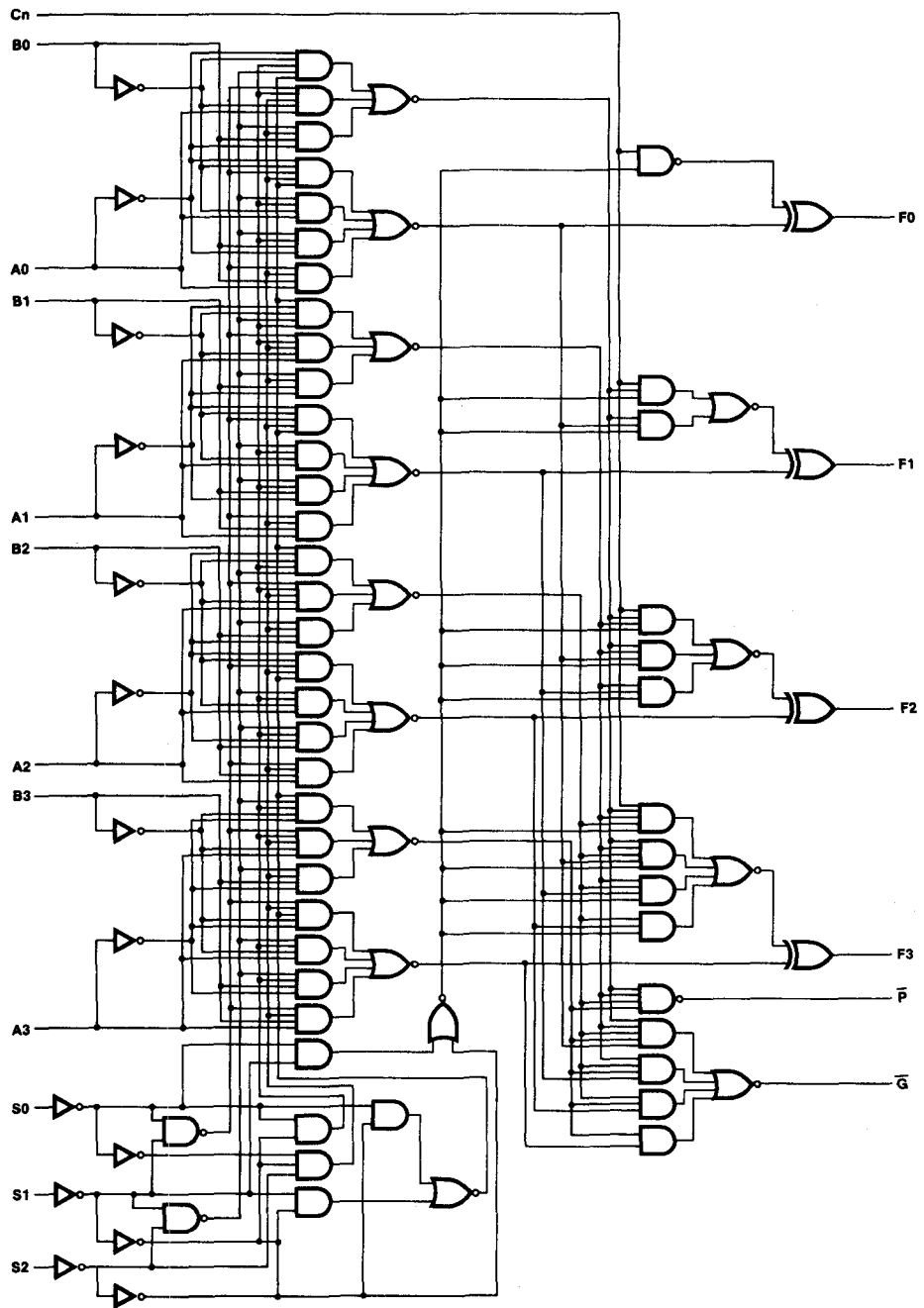
Function Table

FUNCTION	S2	S1	S0	Cn	A3	A2	A1	A0	B3	B2	B1	B0	F3	F2	F1	F0	$\overline{G}$	$\overline{P}$
						INPUTS									**OUTPUTS**			
Clear	0	0	0	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0
B minus A (Inverse Subtraction)	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
				0	0	0	0	0	1	1	1	1	1	1	1	0	0	0
				0	1	1	1	1	0	0	0	0	0	0	0	0	1	1
				0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
				1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				1	0	0	0	0	1	1	1	1	1	1	1	1	0	0
				1	1	1	1	1	0	0	0	0	0	0	0	1	1	1
				1	1	1	1	1	1	1	1	1	0	0	0	0	1	0
A minus B (Subtract)	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
				0	0	0	0	0	1	1	1	1	0	0	0	0	1	1
				0	1	1	1	1	0	0	0	0	1	1	1	0	0	0
				0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
				1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				1	0	0	0	0	1	1	1	1	0	0	0	1	1	1
				1	1	1	1	1	0	0	0	0	1	1	1	1	0	0
				1	1	1	1	1	1	1	1	1	0	0	0	0	1	0
A plus B (Add)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
				0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
				0	1	1	1	1	0	0	0	0	1	1	1	1	1	0
				0	1	1	1	1	1	1	1	1	1	1	1	0	0	0
				1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
				1	0	0	0	0	1	1	1	1	0	0	0	0	1	0
				1	1	1	1	1	0	0	0	0	0	0	0	0	1	0
				1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

Function Table

FUNCTION	S2	S1	S0	Cn	A3	A2	A1	A0	B3	B2	B1	B0	F3	F2	F1	F0
						INPUTS								**OUTPUTS**		
A⊕B (OR)	1	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0
				X	0	0	0	0	1	1	1	1	1	1	1	1
				X	1	1	1	1	0	0	0	0	1	1	1	1
				X	1	1	1	1	1	1	1	1	0	0	0	0
A⊕B (XOR)	1	0	1	X	0	0	0	0	0	0	0	0	0	0	0	0
				X	0	0	0	0	1	1	1	1	1	1	1	1
				X	1	1	1	1	0	0	0	0	1	1	1	1
				X	1	1	1	1	1	1	1	1	1	1	1	1
A • B (AND)	1	1	0	X	0	0	0	0	0	0	0	0	0	0	0	0
				X	0	0	0	0	1	1	1	1	0	0	0	0
				X	1	1	1	1	0	0	0	0	0	0	0	0
				X	1	1	1	1	1	1	1	1	1	1	1	1
Preset	1	1	1	X	0	0	0	0	0	0	0	0	1	1	1	1
				X	0	0	0	0	1	1	1	1	1	1	1	1
				X	1	1	1	1	0	0	0	0	1	1	1	1
				X	1	1	1	1	1	1	1	1	1	1	1	1

1 = HIGH voltage level
0 = LOW voltage level
X = Don't care

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Absolute Maximum Ratings

Supply voltage V_{CC} .... 7 V
Input voltage .... 5.5 V
Storage temperature range .... $-65°$ to $+150°$ C

Operating Conditions

SYMBOL	PARAMETER	COMMERCIAL			UNIT
		MIN	TYP	MAX	
V_{CC}	Supply voltage	4.75	5	5.25	V
T_A	Operating free-air temperature	0		75	°C

Electrical Characteristics Over Operating Conditions

| SYMBOL	PARAMETER	TEST CONDITIONS			COMMERCIAL			UNIT
					MIN	TYP	MAX	
V_{IL}	Low-level input voltage						0.8	V
V_{IH}	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = −18 mA				−1.2	V
I_{IL}	Low-level input current	V_{CC} = MAX	V_I = 0.5 V	Any S input			−2	mA
				Cn			−8	
				All others			−6	
I_{IH}	High-level input current	V_{CC} = MAX	V_I = 2.7 V	Any S input			50	μA
				Cn			250	
				All others			200	
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V				1	mA
V_{OL}	Low-Level output voltage	V_{CC} = MIN V_{IL} = 0.8 V	V_{IH} = 2 V I_{OL} = 20 mA				0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN V_{IL} = 0.8 V	V_{IH} = 2 V I_{OH} = −1 mA		2.7	3.4		V
I_{OS}	Output short-circuit current*	V_{CC} = MAX			−40		−100	mA
I_{CC}	Supply current	V_{CC} = MAX				105	160	mA

* 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

| SYMBOL	PARAMETER	TEST CONDITIONS (See Interface Test Load/Waveforms)	FROM (INPUT)	TO (OUTPUT)	74S381 TYP	MAX	UNIT
t_P	Propagation delay time		C	Any F	10	17	ns
t_P	Propagation delay time		Any A or B	$\overline{G}$	12	20	ns
t_P	Propagation delay time		Any A or B	$\overline{P}$	11	18	ns
t_{PLH}	Propagation delay, low-to-high	C_L = 15 pF R_L = 280Ω	Any A or B	Any F	18	27	ns
t_{PHL}	Propagation delay, high-to-low				16	25	ns
t_P	Propagation delay time		Any S	Any F, $\overline{G}$, $\overline{P}$	18	30	ns

Test Load

*TEST POINT
5V
280Ω
15pF
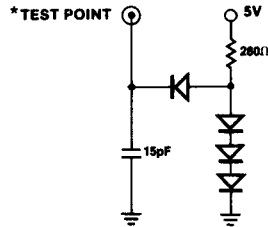
* The "TEST POINT" is driven by the output under test, and observed by instrumentation.

16-BIT ALU (USING 74S381)

74S381

C12
17 ns
C8
C4
20 ns
C0
F
G P
7 ns
74S182
C0

WORST CASE PATH DELAY
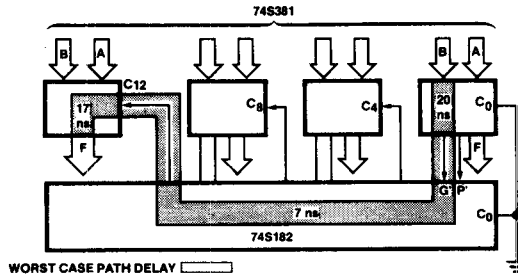
MAXIMUM DELAY OF ADDITION/SUBTRACTION.

	74S381 + 74S182
1-4 bits	27ns
5-16 bits	44ns
17-64 bits	64ns