

74F381 4-Bit Arithmetic Logic Unit

General Description

The 'F381 performs three arithmetic and three logic operations on two 4-bit words, A and B. Two additional select input codes force the function outputs LOW or HIGH. Carry propagate and generate outputs are provided for use with the 'F182 carry lookahead generator for high-speed expansion to longer word lengths. For ripple expansion, refer to the 'F382 ALU data sheet.

Features

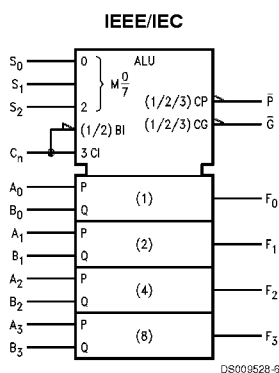
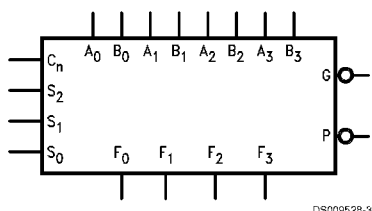
- Low input loading minimizes drive requirements
- Performs six arithmetic and logic functions
- Selectable LOW (clear) and HIGH (preset) functions
- Carry generate and propagate outputs for use with carry lookahead generator

Ordering Code:

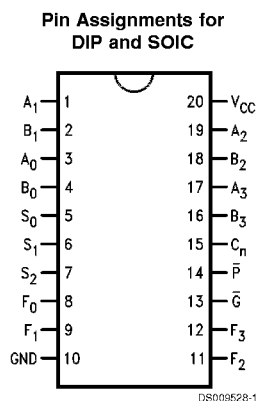
Commercial	Package Number	Package Description
74F381PC	N20A	20-Lead (0.300" Wide) Molded Dual-In-Line
74F381SC (Note 1)	M20B	20-Lead (0.300" Wide) Molded Small Outline, JEDEC
74F381SJ (Note 1)	M20D	20-Lead (0.300" Wide) Molded Small Outline, EIAJ

Note 1: Devices also available in 13" reel. Use suffix = SCX and SJX.

Logic Symbols



Connection Diagram



Unit Loading/Fan Out

Pin Names	Description	74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
A_0-A_3	A Operand Inputs	1.0/3.0	20 μA –1.8 mA
B_0-B_3	B Operand Inputs	1.0/3.0	20 μA –1.8 mA
S_0-S_2	Function Select Inputs	1.0/1.0	20 μA –0.6 mA
C_n	Carry Input	1.0/4.0	20 μA –2.4 mA
$\overline{G}$	Carry Generate Output (Active LOW)	50/33.3	–1 mA/20 mA
$\overline{P}$	Carry Propagate Output (Active LOW)	50/33.3	–1 mA/20 mA
F_0-F_3	Function Outputs	50/33.3	–1 mA/20 mA

Functional Description

Signals applied to the Select inputs S_0-S_2 determine the mode of operation, as indicated in the Function Select Table. An extensive listing of input and output levels is shown in the Truth Table. The circuit performs the arithmetic functions for either active HIGH or active LOW operands, with output levels in the same convention. In the Subtract operating modes, it is necessary to force a carry (HIGH for active HIGH operands, LOW for active LOW operands) into the C_n input of the least significant package.

The Carry Generate ($\overline{G}$) and Carry Propagate ($\overline{P}$) outputs supply input signals to the 'F182 carry lookahead generator for expansion to longer word length, as shown in Figure 2. Note that an 'F382 ALU is used for the most significant package. Typical delays for Figure 2 are given in Figure 1.

Function Select Table

Select			Operation
S_0	S_1	S_2	
L	L	L	Clear
H	L	L	B Minus A
L	H	L	A Minus B
H	H	L	A Plus B
L	L	H	$A \oplus B$
H	L	H	$A + B$
L	H	H	AB
H	H	H	Preset

H = HIGH Voltage Level
L = LOW Voltage Level

Path Segment	Toward F	Output $C_n + 4$, OVR
A_i or B_i to $\overline{P}$	7.2 ns	7.2 ns
$\overline{P}_i$ to $C_n + 1$ ('F182)	6.2 ns	6.2 ns
C_n to F	8.1 ns	—
C_n or $C_n + 4$, OVR	—	8.0 ns
Total Delay	21.5 ns	21.4 ns

FIGURE 1. 16-Bit Delay Tabulation

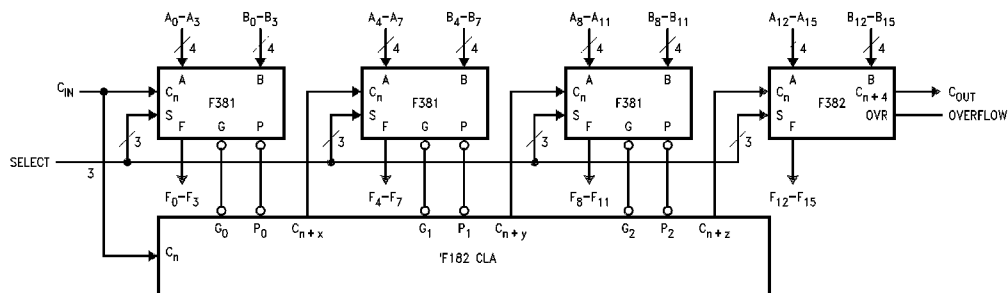
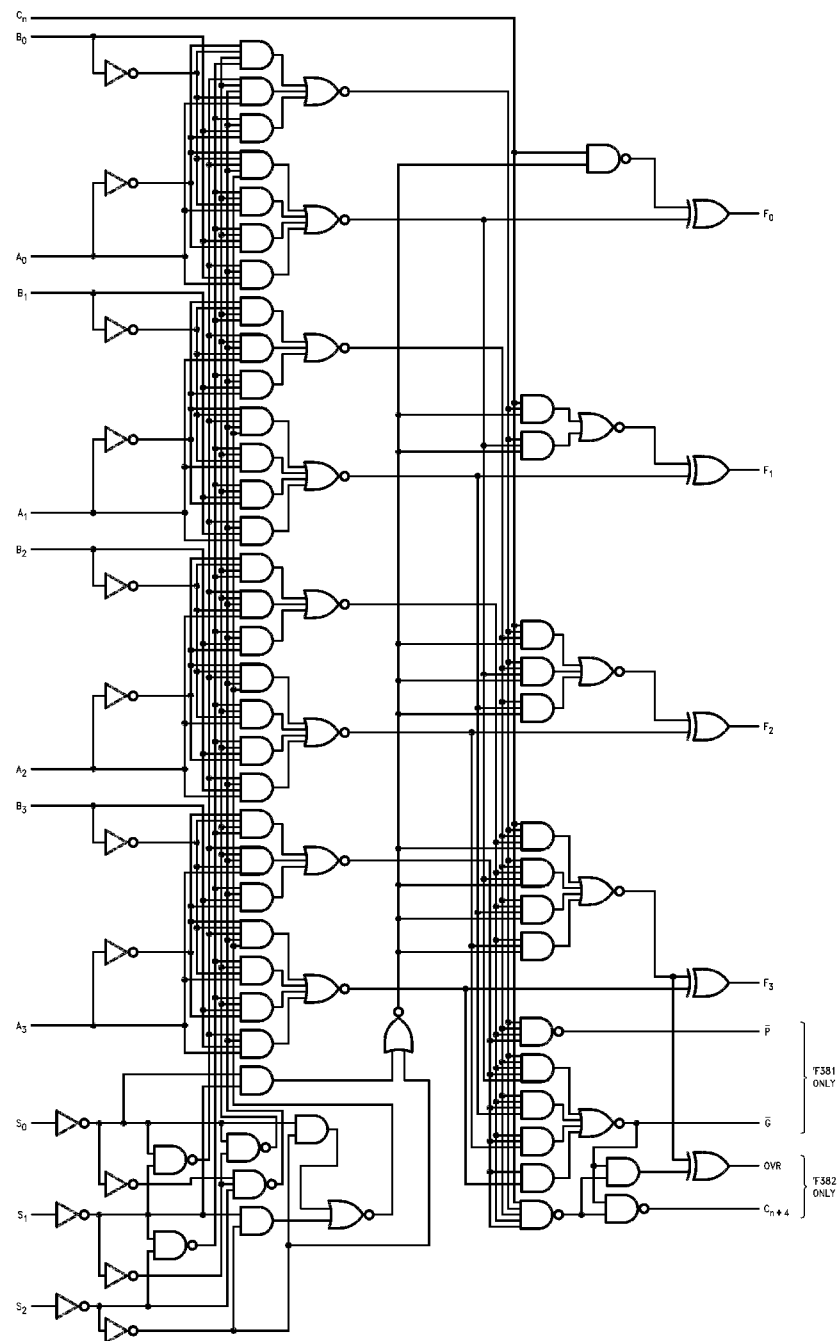


FIGURE 2. 16-Bit Lookahead Carry ALU Expansion

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Logic Diagram



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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Truth Table													
	Inputs						Outputs						
Function	S ₀	S ₁	S ₂	C _n	A _n	B _n	F ₀	F ₁	F ₂	F ₃	$\overline{G}$	$\overline{P}$	
CLEAR	L	L	L	X	X	X	L	L	L	L	L	L	
B Minus A	H	L	L	L	L	L	H	H	H	H	H	L	
				L	L	H	L	H	H	H	L	L	
				L	H	L	L	L	L	L	H	H	
				L	H	H	H	H	H	H	H	L	
				H	L	L	L	L	L	L	H	L	
				H	L	H	H	H	H	H	L	L	
				H	H	L	L	L	L	L	H	H	
A Minus B	L	H	L	L	L	L	H	H	H	H	H	L	
				L	L	H	L	L	L	L	H	H	
				L	H	L	L	H	H	H	L	L	
				L	H	H	H	H	H	H	H	L	
				H	L	L	L	L	L	L	H	L	
				H	L	H	H	L	L	L	H	H	
				H	H	L	L	H	H	H	L	L	
A Plus B	H	H	L	L	L	L	L	L	L	L	H	H	
				L	L	H	L	H	H	H	H	H	L
				L	H	L	L	H	H	H	H	H	L
				L	H	H	H	L	H	H	H	L	L
				H	L	L	L	L	L	L	L	H	H
				H	L	H	H	L	L	L	L	H	L
				H	H	L	L	L	L	L	L	H	L
A ⊕ B	L	L	H	X	L	L	L	L	L	L	H	H	
				X	L	H	H	H	H	H	H	H	H
				X	H	L	H	H	H	H	H	H	L
				X	H	H	L	L	L	L	L	L	L
A + B	H	L	H	X	L	L	L	L	L	L	H	H	
				X	L	H	H	H	H	H	H	H	H
				X	H	L	H	H	H	H	H	H	H
				X	H	H	H	H	H	H	H	H	L
AB	L	H	H	X	L	L	L	L	L	L	L	L	
				X	L	H	L	L	L	L	L	H	H
				X	H	L	L	L	L	L	L	L	L
				X	H	H	H	H	H	H	H	H	L
PRESET	H	H	H	X	L	L	H	H	H	H	H	H	
				X	L	H	H	H	H	H	H	H	H
				X	H	L	H	H	H	H	H	H	H
				X	H	H	H	H	H	H	H	H	L
H = HIGH Voltage Level L = LOW Voltage Level X = Immaterial													

Absolute Maximum Ratings (Note 2)

Storage Temperature	–65°C to +150°C
Ambient Temperature under Bias	–55°C to +125°C
Junction Temperature under Bias	–55°C to +175°C
Plastic	–55°C to +150°C
V _{CC} Pin Potential to Ground Pin	–0.5V to +7.0V
Input Voltage (Note 3)	–0.5V to +7.0V
Input Current (Note 3)	–30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V _{CC} = 0V)	
Standard Output	–0.5V to V _{CC}
3-STATE Output	–0.5V to +5.5V

Current Applied to Output
in LOW State (Max)

twice the rated I_{OL} (mA)

Recommended Operating Conditions

Free Air Ambient Temperature

Commercial

0°C to +70°C

Supply Voltage

Commercial

+4.5V to +5.5V

Note 2: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 3: Either voltage limit or current limit is sufficient to protect inputs.

DC Electrical Characteristics

Symbol	Parameter	74F			Units	V _{CC}	Conditions
		Min	Typ	Max			
V _{IH}	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V _{IL}	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V _{CD}	Input Clamp Diode Voltage			–1.2	V	Min	I _{IN} = –18 mA
V _{OH}	Output HIGH Voltage	74F 10% V _{CC}	2.5		V	Min	I _{OH} = –1 mA
		74F 5% V _{CC}	2.7				I _{OH} = –1 mA
V _{OL}	Output LOW Voltage	74F 10% V _{CC}		0.5	V	Min	I _{OL} = 20 mA
I _{IH}	Input HIGH Current	74F		5.0	μA		V _{IN} = 2.7V
I _{BVI}	Input HIGH Current Breakdown Test	74F		7.0	μA	Max	V _{IN} = 7.0V
I _{CEX}	Output HIGH Leakage Current	74F		50	μA	Max	V _{OUT} = V _{CC}
V _{ID}	Input Leakage Test	74F	4.75		V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{OD}	Output Leakage Circuit Current	74F		3.75	μA	0.0	V _{ID} = 150 mV All Other Pins Grounded
I _{IL}	Input LOW Current			–0.6	mA	Max	V _{IN} = 0.5V (S _n)
				–1.8	mA	Max	V _{IN} = 0.5V (A _n , B _n)
				–2.4	mA	Max	V _{IN} = 0.5V (C _n)
I _{OS}	Output Short-Circuit Current		–60	–150	mA	Max	V _{OUT} = 0V
I _{CC}	Power Supply Current		59	89	mA	Max	

AC Electrical Characteristics

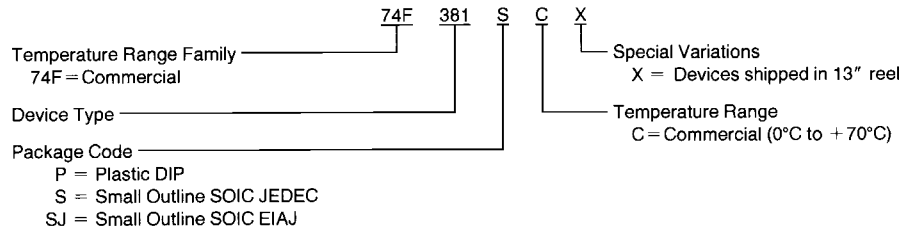
Symbol	Parameter	74F			74F		Units
		T _A = +25°C V _{CC} = +5.0V C _L = 50 pF			T _A , V _{CC} = Com C _L = 50 pF		
		Min	Typ	Max	Min	Max	
t _{PLH}	Propagation Delay	2.5	8.1	12.0	2.5	13.0	ns
t _{PHL}	C _n to F _i	2.5	5.7	8.0	2.5	9.0	

AC Electrical Characteristics (Continued)

Symbol	Parameter	74F			74F		Units
		$T_A = +25^{\circ}\text{C}$ $V_{CC} = +5.0\text{V}$ $C_L = 50\text{ pF}$			$T_A, V_{CC} = \text{Com}$ $C_L = 50\text{ pF}$		
		Min	Typ	Max	Min	Max	
t_{PLH}	Propagation Delay	4.0	10.4	15.0	4.0	16.0	ns
t_{PHL}	Any A or B to Any F	3.5	8.2	11.0	3.5	12.0	
t_{PLH}	Propagation Delay	4.5	8.3	20.5	4.5	21.5	ns
t_{PHL}	S_i to F_i	4.0	8.2	15.0	4.0	16.0	
t_{PLH}	Propagation Delay	3.5	6.4	10.0	3.5	11.0	ns
t_{PHL}	A_i or B_i to $\overline{G}$	3.5	6.8	10.0	3.0	11.0	
t_{PLH}	Propagation Delay	2.5	7.2	10.5	2.5	11.5	ns
t_{PHL}	A_i or B_i to $\overline{P}$	3.5	6.5	9.5	3.5	10.5	
t_{PLH}	Propagation Delay	4.0	7.8	12.0	4.0	13.0	ns
t_{PHL}	S_i to $\overline{G}$ or $\overline{P}$	4.5	10.2	13.5	4.5	14.5	

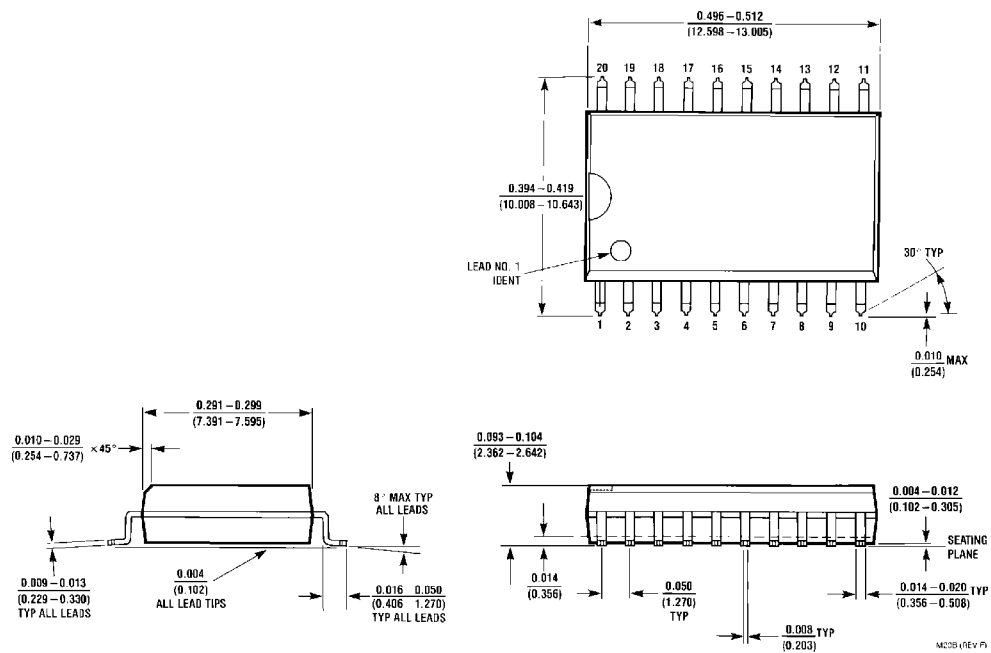
Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:

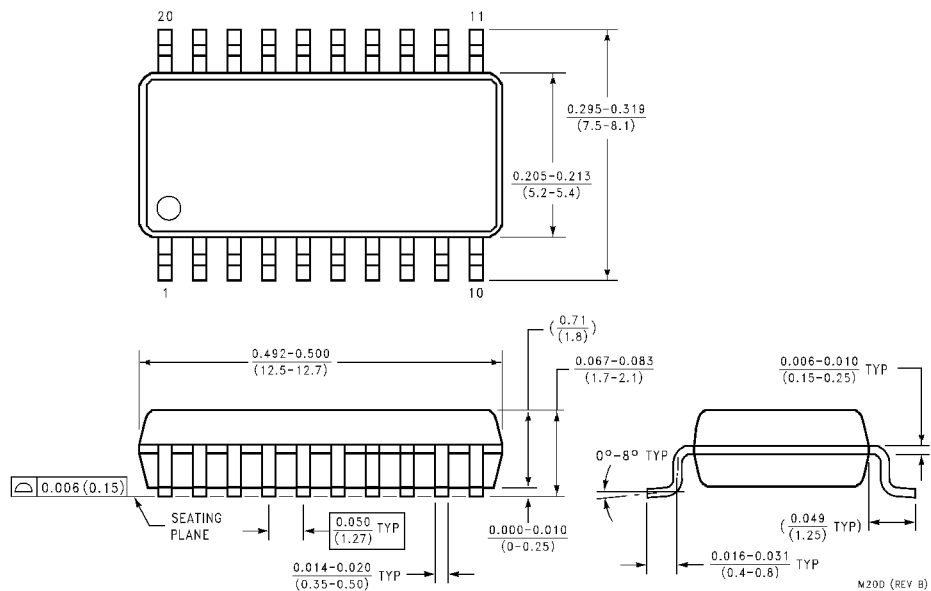


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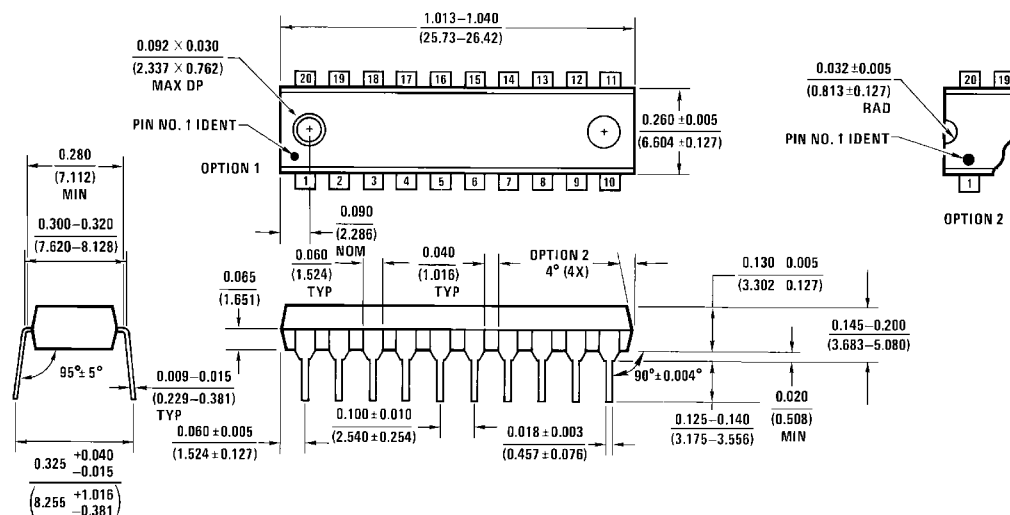
Physical Dimensions inches (millimeters) unless otherwise noted



20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC (S)
Package Number M20B



20-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)
Package Number M20D

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

N20A (REV G)

20-Lead (0.300" Wide) Molded Dual-In-Line Package (P)
Package Number N20A

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Fairchild Semiconductor
 Corporation
 Americas
 Customer Response Center
 Tel: 1-888-522-5372

Fairchild Semiconductor
 Europe
 Fax: +49 (0) 1 80-530 85 86
 Email: europe.support@nsc.com
 Deutsch Tel: +49 (0) 8 141-35-0
 English Tel: +44 (0) 1 793-85-68-56
 Italy Tel: +39 (0) 2 57 5631

Fairchild Semiconductor
 Hong Kong Ltd.
 13th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: +852 2737-7200
 Fax: +852 2314-0061

National Semiconductor
 Japan Ltd.
 Tel: 81-3-5620-6175
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