National Semiconductor

DM74S381 Arithmetic Logic Unit/Function Generator

General Description

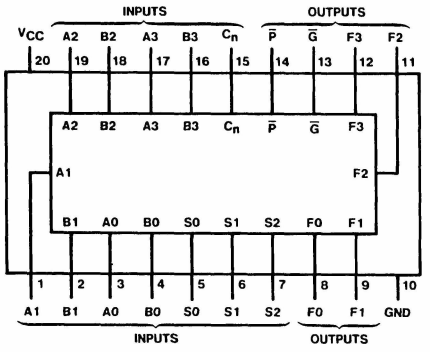
The 'S381 is a Schottky TTL arithmetic logic unit (ALU)/function generator that performs eight binary arithmetic/logic operations on two 4-bit words as shown in the function table. These operations are selected by the three function-select lines (S0, S1, S2). A full carry look-ahead circuit is provided for fast, simultaneous carry generation by means of two cascade outputs ($\overline{P}$ and $\overline{G}$) for the four bits in the package. The method of cascading 54S182/74S182 look-ahead carry generators with these ALU's to provide multi-level full carry look-ahead is illustated under typical applications data for the 'S182. The typical addition times shown illustrate the short delay time required for addition of longer words when full look-ahead is employed. The exclusive-OR, AND, or OR function of two Boolean variables is provided without the use of external circuitry. Also, the outputs can be either cleared (low) or preset (high) as desired.

Features

- A fully parallel 4-Bit ALU in 20-pin package for 0.300-inch row spacing
- Ideally suited for high-density economical processors
- Parallel inputs and outputs and full look-ahead provide system flexibility
- Arithmetic and logic operations selected specifically to simplify system implementation:
  - A minus B
  - B minus A
  - A plus B
  - and five other functions
- Schottky-clamped for high performance
  - 16-bit add time . . . 26 ns typ using look-ahead
  - 32-bit add time . . . 34 ns typ using look-ahead

Connection Diagram

Dual-In-Line Package



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Order Number DM74S381N
See NS Package Number N20A

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 ⊕ B
H	L	H	A + B
H	H	L	AB
H	H	H	PRESET

H = high level, L = low level

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
$\overline{P}$	14	Inverted Carry Propagate Output
$\overline{G}$	13	Inverted Carry Generated Output
V_{CC}	20	Supply Voltage
GND	10	Ground

Absolute Maximum Ratings (Note)

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note: *The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.*

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	High Level Input Voltage	2			V
V_{IL}	Low Level Input Voltage			0.8	V
I_{OH}	High Level Output Current			−1	mA
I_{OL}	Low Level Output Current			20	mA
T_A	Free Air Operating Temperature	0		70	°C

Electrical Characteristics over recommended operating free air temperature (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA				−1.2	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max, V_{IH} = Min		2.7	3.4		V
V_{OL}	Low Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IH} = Min, V_{IL} = Max				0.5	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V				1	mA
I_{IH}	High Level Input Current	V_{CC} = Max V_I = 2.7V	Any S			50	μA
			Cn			250	
			Any Other			200	
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.5V	Any S			−2	mA
			Cn			−8	
			Any Other			−6	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)		−40		−100	mA
I_{CC}	Supply Current	V_{CC} = Max			105	160	mA

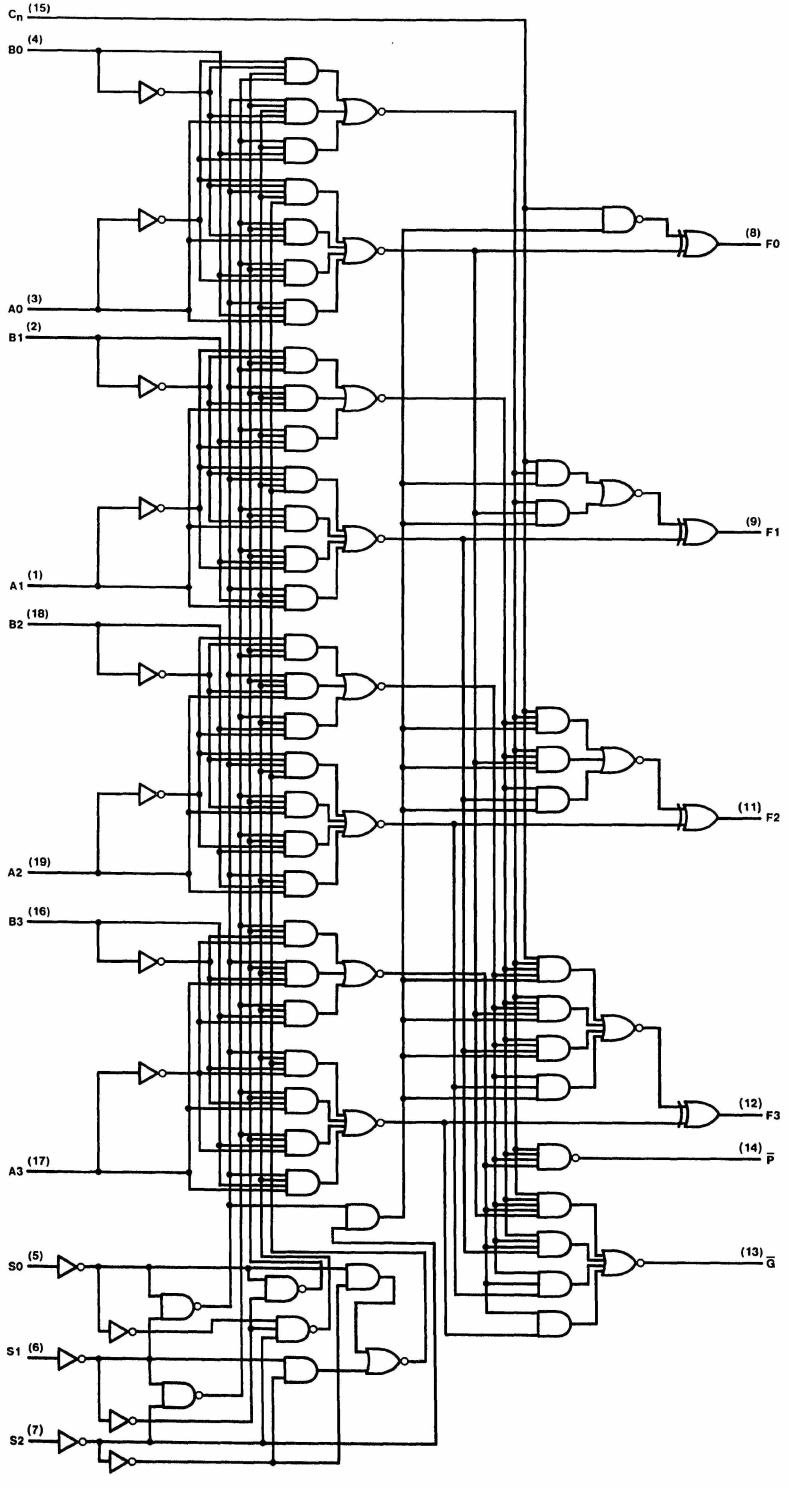
Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Switching Characteristics at V_{CC} = 5V and T_A = 25°C (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	From (Input) To (Output)	R_L = 280Ω				Units
			C_L = 15 pF		C_L = 50 pF		
			Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time Low to High Level Output	Cn to Any F		17		19	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Cn to Any F		17		19	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	A or B to $\overline{G}$		20		23	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	A or B to $\overline{G}$		20		23	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	A or B to $\overline{P}$		18		21	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	A or B to $\overline{P}$		18		21	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	A_i or B_i to F_i		27		30	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	A_i or B_i to F_i		25		27	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	S to Any		30		33	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	S to Any		30		33	ns

Logic Diagram



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