

**For:char**

**Printed on:Mon, Feb 6, 1995 09:49:45**

**From book:DL121CH4 (5) VIEW**

**Document:MC74F381 (5) VIEW**

**Last saved on:Fri, Feb 3, 1995 16:06:52**

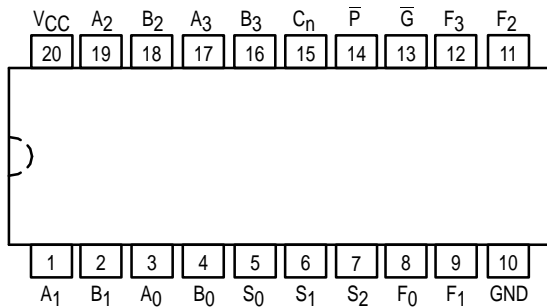


# 4-BIT ARITHMETIC LOGIC UNIT

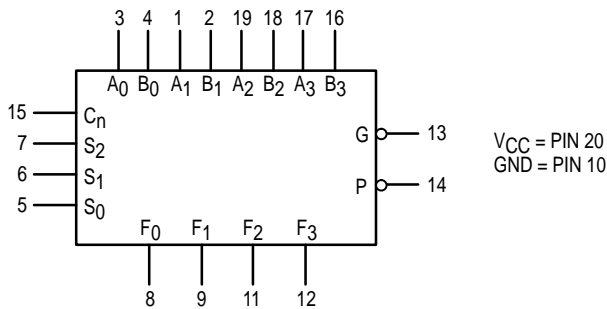
The MC54/74F381 performs three arithmetic and three logic operations on two 4-bit words, A and B. Two additional Select input codes force the Function outputs LOW or HIGH. Carry Propagate and Generate outputs are provided for use with the F182 Carry Lookahead Generator for high-speed expansion to longer word lengths. For ripple expansion, refer to the F382 ALU data sheet.

- 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

### CONNECTION DIAGRAM

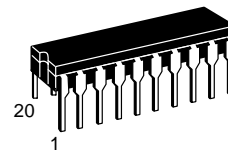


### LOGIC SYMBOL

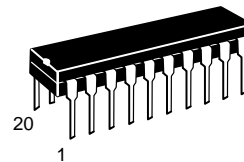


## MC54/74F381

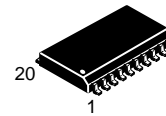
### 4-BIT ARITHMETIC LOGIC UNIT FAST™ SCHOTTKY TTL



**J SUFFIX**  
CERAMIC  
CASE 732-03



**N SUFFIX**  
PLASTIC  
CASE 738-03



**DW SUFFIX**  
SOIC  
CASE 751D-03

### ORDERING INFORMATION

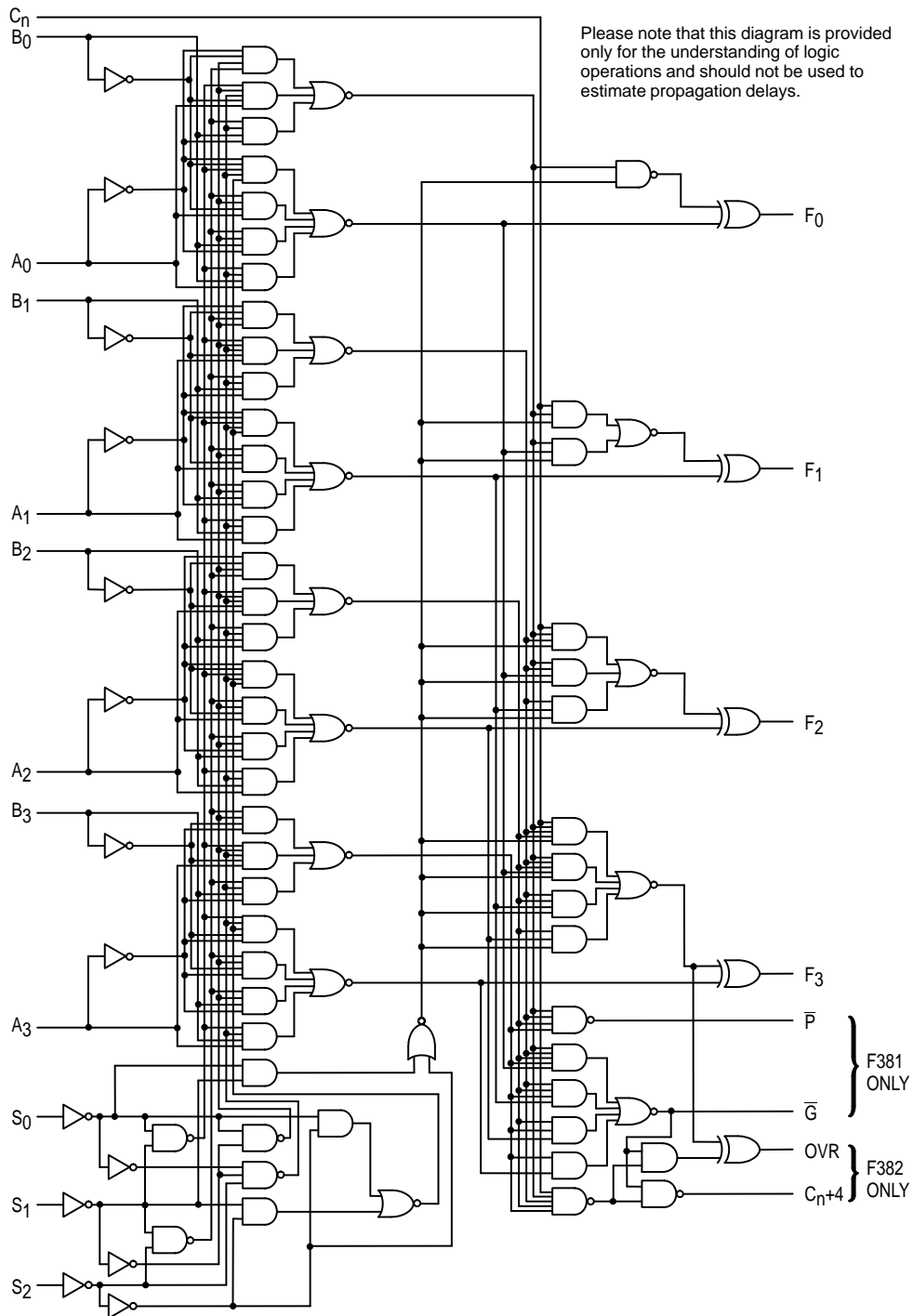
MC54FXXXJ Ceramic  
MC74FXXXN Plastic  
MC74FXXXDW SOIC

### GUARANTEED OPERATING RANGES

| Symbol   | Parameter                           |        | Min | Typ | Max  | Unit |
|----------|-------------------------------------|--------|-----|-----|------|------|
| $V_{CC}$ | Supply Voltage                      | 54, 74 | 4.5 | 5.0 | 5.5  | V    |
| $T_A$    | Operating Ambient Temperature Range | 54     | -55 | 25  | 125  | °C   |
|          |                                     | 74     | 0   | 25  | 70   |      |
| $I_{OH}$ | Output Current — High               | 54, 74 |     |     | -1.0 | mA   |
| $I_{OL}$ | Output Current — Low                | 54, 74 |     |     | 20   | mA   |

# MC54/74F381

## LOGIC DIAGRAM



# MC54/74F381

## DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

| Symbol          | Parameter  | Limits |      |      | Unit | Test Conditions  |                          |
|-----------------|--|--------|------|------|------|--|--------------------------|
|                 |  | Min    | Typ  | Max  |      |  |                          |
| V <sub>IH</sub> | Input HIGH Voltage   | 2.0    |      |      | V    | Guaranteed Input HIGH Voltage                              |                          |
| V <sub>IL</sub> | Input LOW Voltage  |        |      | 0.8  | V    | Guaranteed Input LOW Voltage                               |                          |
| V <sub>IK</sub> | Input Clamp Diode Voltage                                  |        |      | -1.2 | V    | I <sub>IN</sub> = -18 mA                                   | V <sub>CC</sub> = MIN    |
| V <sub>OH</sub> | Output HIGH Voltage  | 54, 74 | 2.5  | 3.4  | V    | I <sub>OH</sub> = -1.0 mA                                  | V <sub>CC</sub> = 4.5 V  |
|                 |  | 74     | 2.7  | 3.4  | V    | I <sub>OH</sub> = -1.0 mA                                  | V <sub>CC</sub> = 4.75 V |
| V <sub>OL</sub> | Output LOW Voltage   |        | 0.35 | 0.5  | V    | I <sub>OL</sub> = 20 mA                                    | V <sub>CC</sub> = MIN    |
| I <sub>IH</sub> | Input HIGH Current   |        |      | 20   | μA   | V <sub>IN</sub> = 2.7 V                                    | V <sub>CC</sub> = MAX    |
|                 |  |        |      | 100  | μA   | V <sub>IN</sub> = 7.0 V                                    |                          |
| I <sub>IL</sub> | Input LOW Current<br>S <sub>0</sub> -S <sub>2</sub> Inputs |        |      | -0.6 | mA   | V <sub>IN</sub> = 0.5 V                                    | V <sub>CC</sub> = MAX    |
|                 | Other Inputs   |        |      | -2.4 | mA   | V <sub>IN</sub> = 0.5 V                                    |                          |
| I <sub>OS</sub> | Output Short Circuit Current (Note 2)                      | -60    |      | -150 | mA   | V <sub>OUT</sub> = 0 V                                     | V <sub>CC</sub> = MAX    |
| I <sub>CC</sub> | Power Supply Current                                       |        | 59   | 89   | mA   | S <sub>0</sub> -S <sub>2</sub> = GND;<br>Other Inputs HIGH | V <sub>CC</sub> = MAX    |

### NOTES:

1. For conditions such as MIN or MAX, use the appropriate value specified under guaranteed operating ranges.
2. Not more than one output should be shorted at a time, nor for more than 1 second.

## FUNCTIONAL DESCRIPTION

Signals applied to the Select inputs S<sub>0</sub>-S<sub>2</sub> 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 oper-

ands, LOW for active-LOW operands) into the C<sub>n</sub> input of the least significant package.

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

FUNCTION SELECT TABLE

| Select         |                |                | Operation |
|----------------|----------------|----------------|-----------|
| S <sub>0</sub> | S <sub>1</sub> | S <sub>2</sub> |           |
| 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⊕B       |
| H              | L              | H              | A + B     |
| L              | H              | H              | AB        |
| H              | H              | H              | Preset    |

H = HIGH Voltage Level

L = LOW Voltage Level

# MC54/74F381

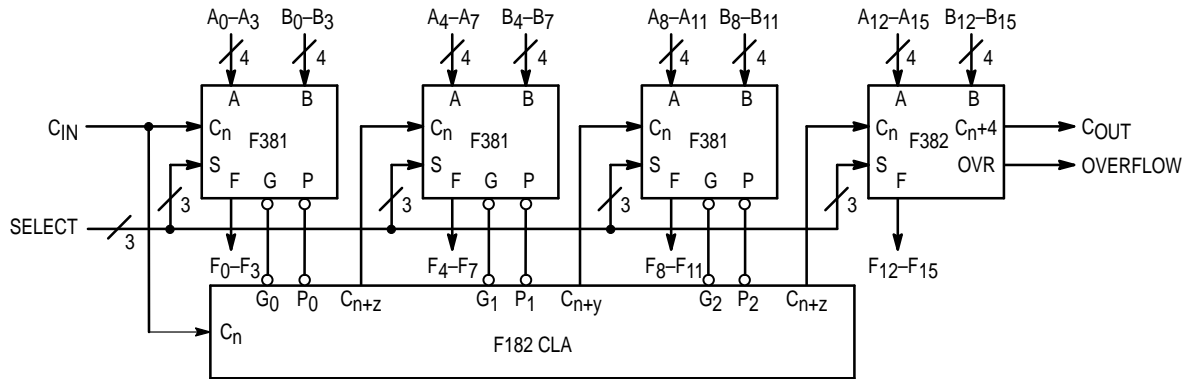


Figure 1. 16-Bit Lookahead Carry ALU Expansion

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

Figure 2. 16-Bit Delay Tabulation

## AC CHARACTERISTICS

| Symbol                 | Parameter  | 54/74F  |      |      | 54F  |      | 74F   |      | Unit |
|------------------------|--|---|------|------|--|------|---|------|------|
|                        |  | $T_A = +25^\circ\text{C}$<br>$V_{CC} = +5.0\text{ V}$<br>$C_L = 50\text{ pF}$ |      |      | $T_A = -55\text{ to }+125^\circ\text{C}$<br>$V_{CC} = 5.0\text{ V} \pm 10\%$<br>$C_L = 50\text{ pF}$ |      | $T_A = 0\text{ to }+70^\circ\text{C}$<br>$V_{CC} = 5.0\text{ V} \pm 10\%$<br>$C_L = 50\text{ pF}$ |      |      |
|                        |  | Min   | Typ  | Max  | Min  | Max  | Min   | Max  |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$C_n$ to $F_i$                  | 2.5   | 8.1  | 12   | 2.5  | 15   | 2.5   | 13   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Any A or B to Any F             | 4.0   | 10.4 | 15   | 4.0  | 18   | 4.0   | 16   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation<br>$S_i$ to $F_i$                        | 4.5   | 8.3  | 20   | 4.5  | 23.5 | 4.5   | 21.5 | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$A_i$ or $B_i$ to $\bar{G}$     | 3.0   | 6.4  | 9.0  | 3.0  | 12   | 3.0   | 10   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$A_i$ or $B_i$ to $\bar{P}$     | 2.5   | 7.2  | 10.5 | 2.5  | 13.5 | 2.5   | 11.5 | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$S_i$ to $\bar{G}$ or $\bar{P}$ | 4.0   | 7.8  | 12   | 4.0  | 15   | 4.0   | 13   | ns   |

# MC54/74F381

TRUTH TABLE

| FUNCTION  | INPUTS         |                |                |                |                |                | OUTPUTS        |                |                |                |           |   |   |   |
|-----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------|---|---|---|
|           | S <sub>0</sub> | S <sub>1</sub> | S <sub>2</sub> | C <sub>n</sub> | A <sub>n</sub> | B <sub>n</sub> | F <sub>0</sub> | F <sub>1</sub> | F <sub>2</sub> | F <sub>3</sub> | $\bar{G}$ | P |   |   |
| CLEAR     | 0              | 0              | 0              | X              | X              | X              | 0              | 0              | 0              | 0              | 0         | 0 |   |   |
| B MINUS A | 1              | 0              | 0              | 0              | 0              | 0              | 1              | 1              | 1              | 1              | 1         | 0 |   |   |
|           |                |                |                | 0              | 0              | 1              | 0              | 1              | 1              | 1              | 0         | 0 |   |   |
|           |                |                |                | 0              | 1              | 0              | 0              | 0              | 0              | 0              | 0         | 1 | 1 |   |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |
|           |                |                |                | 1              | 0              | 0              | 0              | 0              | 0              | 0              | 0         | 0 | 1 | 0 |
|           |                |                |                | 1              | 0              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 | 0 |
|           |                |                |                | 1              | 1              | 0              | 1              | 0              | 0              | 1              | 0         | 0 | 0 | 1 |
| A MINUS B | 0              | 1              | 0              | 0              | 0              | 0              | 1              | 1              | 1              | 1              | 1         | 0 |   |   |
|           |                |                |                | 0              | 0              | 1              | 0              | 0              | 0              | 0              | 0         | 1 | 1 |   |
|           |                |                |                | 0              | 1              | 0              | 0              | 1              | 1              | 1              | 1         | 0 | 0 |   |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |
|           |                |                |                | 1              | 0              | 0              | 0              | 0              | 0              | 0              | 0         | 0 | 1 | 0 |
|           |                |                |                | 1              | 0              | 1              | 1              | 1              | 1              | 0              | 0         | 0 | 1 | 1 |
|           |                |                |                | 1              | 1              | 0              | 1              | 0              | 0              | 1              | 1         | 1 | 1 | 0 |
| A PLUS B  | 1              | 1              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 1         | 1 |   |   |
|           |                |                |                | 0              | 0              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |
|           |                |                |                | 0              | 1              | 0              | 0              | 1              | 1              | 1              | 1         | 1 | 0 |   |
|           |                |                |                | 0              | 1              | 1              | 1              | 0              | 1              | 1              | 1         | 0 | 0 |   |
|           |                |                |                | 1              | 0              | 0              | 0              | 1              | 0              | 0              | 0         | 0 | 1 | 1 |
|           |                |                |                | 1              | 0              | 1              | 1              | 0              | 0              | 0              | 0         | 0 | 1 | 0 |
|           |                |                |                | 1              | 1              | 0              | 0              | 0              | 0              | 0              | 0         | 0 | 1 | 0 |
| A⊕B       | 0              | 0              | 1              | X              | 0              | 0              | 0              | 0              | 0              | 0              | 0         | 0 |   |   |
|           |                |                |                | X              | 0              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 1 |   |
|           |                |                |                | X              | 1              | 0              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |
|           |                |                |                | X              | 1              | 1              | 1              | 0              | 0              | 0              | 0         | 0 | 0 |   |
| A+B       | 1              | 0              | 1              | X              | 0              | 0              | 0              | 0              | 0              | 0              | 0         | 0 |   |   |
|           |                |                |                | X              | 0              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 1 |   |
|           |                |                |                | X              | 1              | 0              | 1              | 1              | 1              | 1              | 1         | 1 | 1 |   |
|           |                |                |                | X              | 1              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |
| AB        | 0              | 1              | 1              | X              | 0              | 0              | 0              | 0              | 0              | 0              | 0         | 0 |   |   |
|           |                |                |                | X              | 0              | 1              | 0              | 0              | 0              | 0              | 0         | 1 | 1 |   |
|           |                |                |                | X              | 1              | 0              | 0              | 0              | 0              | 0              | 0         | 0 | 0 |   |
|           |                |                |                | X              | 1              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |
| PRESET    | 1              | 1              | 1              | X              | 0              | 0              | 1              | 1              | 1              | 1              | 1         | 1 |   |   |
|           |                |                |                | X              | 0              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 1 |   |
|           |                |                |                | X              | 1              | 0              | 1              | 1              | 1              | 1              | 1         | 1 | 1 |   |
|           |                |                |                | X              | 1              | 1              | 1              | 1              | 1              | 1              | 1         | 1 | 0 |   |

1 = HIGH Voltage Level  
 0 = LOW Voltage Level  
 X = Immaterial