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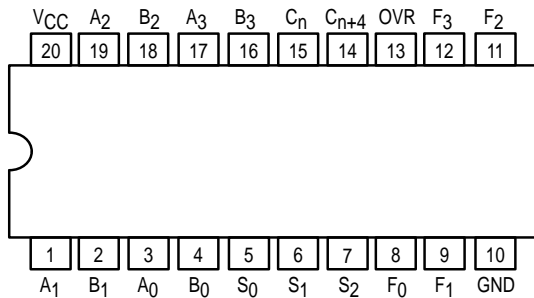


# 4-BIT ARITHMETIC LOGIC UNIT

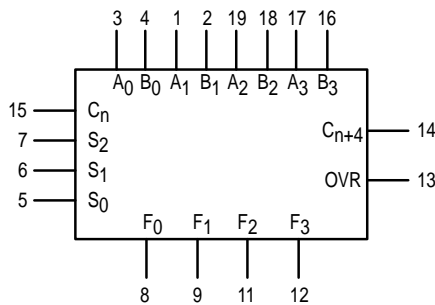
The MC54/74F382 performs three arithmetic and three logic operations on two 4-bit words, A and B. Two additional Select input codes force the Function outputs LOW or HIGH. An Overflow output is provided for convenience in twos complement arithmetic. A Carry output is provided for ripple expansion. For high-speed expansion using a Carry Lookahead Generator, refer to the F381 data sheet.

- Performs Six Arithmetic and Logic Functions
- Selectable Low (Clear) and High (Preset) Functions
- LOW Input Loading Minimizes Drive Requirements
- Carry Output for Ripple Expansion
- Overflow Output for Twos Complement Arithmetic

### CONNECTION DIAGRAM



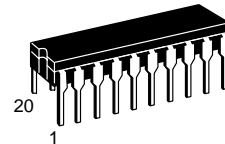
### LOGIC SYMBOL



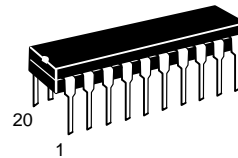
## MC54/74F382

### 4-BIT ARITHMETIC LOGIC UNIT

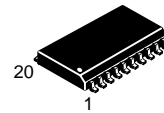
FAST™ SCHOTTKY TTL



**J SUFFIX**  
CERAMIC  
CASE 732-03



**N SUFFIX**  
PLASTIC  
CASE 738-03



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

### ORDERING INFORMATION

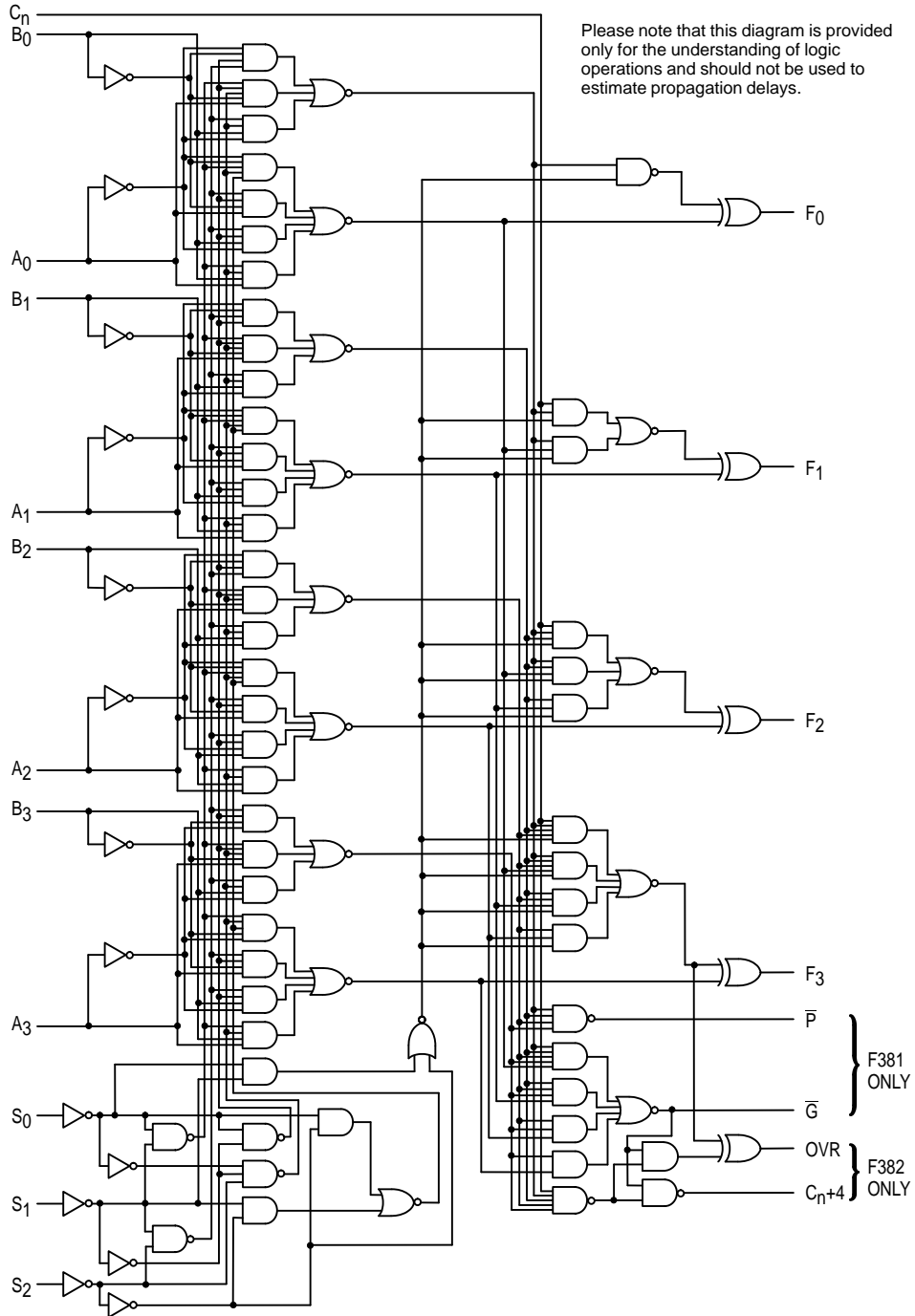
MC54FXXXJ Ceramic  
MC74FXXXN Plastic  
MC74FXXXDW SOIC

### GUARANTEED OPERATING RANGES

| Symbol          | Parameter                           |        | Min | Typ | Max  | Unit |
|-----------------|-------------------------------------|--------|-----|-----|------|------|
| V <sub>CC</sub> | Supply Voltage                      | 54, 74 | 4.5 | 5.0 | 5.5  | V    |
| T <sub>A</sub>  | Operating Ambient Temperature Range | 54     | -55 | 25  | 125  | °C   |
|                 |                                     | 74     | 0   | 25  | 70   |      |
| I <sub>OH</sub> | Output Current — High               | 54, 74 |     |     | -1.0 | mA   |
| I <sub>OL</sub> | Output Current — Low                | 54, 74 |     |     | 20   | mA   |

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## LOGIC DIAGRAM



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## 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   |   |                          |
|                 | C <sub>n</sub> Input                                       |        |      | -3.0 | mA   |   |                          |
| 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                                       |        | 54   | 81   | mA   | S <sub>0</sub> , C <sub>n</sub> = HIGH;<br>Other Inputs GND | 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 operands,

LOW for active LOW operands) into the C<sub>n</sub> input of the least significant package. Ripple expansion is illustrated in Figure 1. The overflow output OVR is the Exclusive-OR of C<sub>n+3</sub> and C<sub>n+4</sub>; a HIGH signal on OVR indicates overflow in twos complement operation. Typical delays for Figure 1 are given in Figure 2.

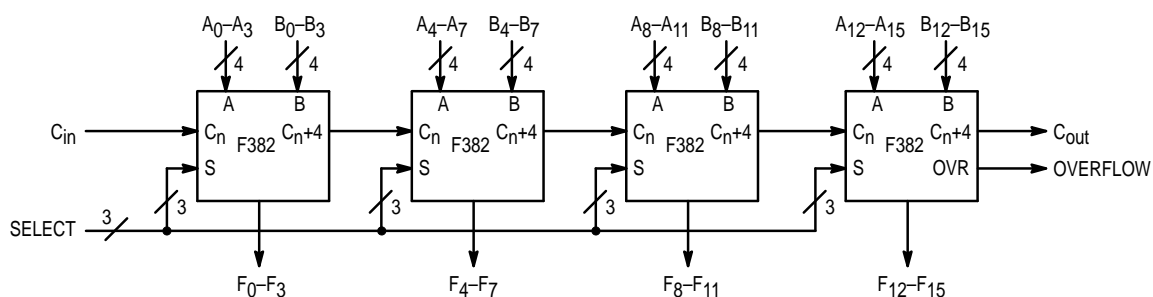
FUNCTION SELECT TABLE

| 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

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**Figure 1. 16-Bit Ripple Carry ALU Expansion**

| Path Segment                | Toward F       | Output $C_n + 4$ , OVR |
|-----------------------------|----------------|------------------------|
| $A_i$ or $B_i$ to $C_n + 4$ | 6.5 ns         | 6.5 ns                 |
| $C_n$ to $C_n + 4$          | 6.3 ns         | 6.3 ns                 |
| $C_n$ to $C_n + 4$          | 6.3 ns         | 6.3 ns                 |
| $C_n$ to F                  | 8.1            | —                      |
| $C_n$ to $C_n + 4$ , OVR    | —              | 8.0 ns                 |
| <b>Total Delay</b>          | <b>27.2 ns</b> | <b>27.1 ns</b>         |

**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 $F_i$              | 3.0<br>2.5  | 8.1<br>5.7  | 12<br>8.0    | 3.0<br>2.5  | 15<br>11     | 3.0<br>2.5  | 13<br>9.0    | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Any A or B to Any F         | 4.0<br>3.5  | 10.4<br>8.2 | 15<br>11     | 4.0<br>3.5  | 18<br>14     | 4.0<br>3.5  | 16<br>12     | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$S_j$ to $F_i$              | 6.0<br>4.0  | 11<br>8.2   | 15<br>20.5   | 6.0<br>4.0  | 21<br>23.5   | 6.0<br>4.0  | 16<br>21.5   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$A_i$ or $B_i$ to $C_n + 4$ | 3.5<br>3.0  | 6.0<br>6.5  | 8.5<br>9.0   | 3.5<br>3.0  | 11.5<br>12.5 | 3.5<br>3.0  | 9.5<br>10.5  | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$S_j$ to OVR or $C_n + 4$   | 7.0<br>4.5  | 12.5<br>9.0 | 16.5<br>12   | 7.0<br>4.5  | 19.5<br>15   | 7.0<br>4.5  | 17.5<br>13   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$C_n$ to $C_n + 4$          | 2.5<br>2.5  | 5.6<br>6.3  | 8.0<br>9.0   | 2.5<br>2.5  | 11<br>12     | 2.5<br>2.5  | 9.0<br>10    | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$C_n$ to OVR                | 3.5<br>3.5  | 8.0<br>7.1  | 11<br>10     | 3.5<br>3.5  | 14<br>13     | 3.5<br>3.5  | 12<br>11     | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$A_i$ or $B_i$ to OVR       | 6.5<br>5.5  | 11.5<br>8.0 | 15.5<br>10.5 | 6.5<br>5.5  | 18.5<br>13.5 | 6.5<br>5.5  | 16.5<br>11.5 | ns   |

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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> | OVR | C <sub>n+4</sub> |   |
| CLEAR     | 0              | 0              | 0              | 0              | X              | X              | 0              | 0              | 0              | 0              | 1   | 1                |   |
|           |                |                |                | 1              | X              | X              | 0              | 0              | 0              | 0              | 1   | 1                |   |
| B MINUS A | 1              | 0              | 0              | 0              | 0              | 0              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 0              | 0              | 1              | 0              | 1              | 1              | 1              | 0   | 1                |   |
|           |                |                |                | 0              | 1              | 0              | 0              | 0              | 0              | 0              | 0   | 0                | 0 |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 1   | 0                | 0 |
|           |                |                |                | 1              | 0              | 0              | 0              | 0              | 0              | 0              | 0   | 0                | 1 |
|           |                |                |                | 1              | 0              | 1              | 1              | 1              | 1              | 1              | 1   | 0                | 1 |
|           |                |                |                | 1              | 1              | 0              | 1              | 0              | 0              | 0              | 0   | 0                | 0 |
| A MINUS B | 0              | 1              | 0              | 0              | 0              | 0              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 0              | 0              | 1              | 0              | 0              | 0              | 0              | 0   | 0                | 0 |
|           |                |                |                | 0              | 1              | 0              | 0              | 1              | 1              | 1              | 1   | 0                | 1 |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 1   | 0                | 0 |
|           |                |                |                | 1              | 0              | 0              | 0              | 0              | 0              | 0              | 0   | 0                | 1 |
|           |                |                |                | 1              | 0              | 1              | 1              | 0              | 0              | 0              | 0   | 0                | 0 |
|           |                |                |                | 1              | 1              | 0              | 1              | 1              | 1              | 1              | 1   | 0                | 1 |
| A PLUS B  | 1              | 1              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0   | 0                |   |
|           |                |                |                | 0              | 0              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 0              | 1              | 0              | 0              | 1              | 1              | 1              | 1   | 0                | 0 |
|           |                |                |                | 0              | 1              | 1              | 1              | 0              | 1              | 1              | 1   | 0                | 1 |
|           |                |                |                | 1              | 0              | 0              | 0              | 1              | 0              | 0              | 0   | 0                | 0 |
|           |                |                |                | 1              | 0              | 1              | 1              | 0              | 0              | 0              | 0   | 0                | 1 |
|           |                |                |                | 1              | 1              | 0              | 0              | 0              | 0              | 0              | 0   | 0                | 1 |
| A⊕B       | 0              | 0              | 1              | X              | 0              | 0              | 0              | 0              | 0              | 0              | 0   | 0                |   |
|           |                |                |                | X              | 0              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 0              | 1              | 0              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | X              | 1              | 1              | 0              | 0              | 0              | 0              | 1   | 1                |   |
|           |                |                |                | 1              | 1              | 0              | 1              | 1              | 1              | 1              | 1   | 1                |   |
| A + B     | 1              | 0              | 1              | X              | 0              | 0              | 0              | 0              | 0              | 0              | 0   | 0                |   |
|           |                |                |                | X              | 0              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | X              | 1              | 0              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1   | 1                |   |
| AB        | 0              | 1              | 1              | X              | 0              | 0              | 0              | 0              | 0              | 0              | 1   | 1                |   |
|           |                |                |                | X              | 0              | 1              | 0              | 0              | 0              | 0              | 0   | 0                |   |
|           |                |                |                | X              | 1              | 0              | 0              | 0              | 0              | 0              | 1   | 1                |   |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1   | 1                |   |
| PRESET    | 1              | 1              | 1              | X              | 0              | 0              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | X              | 0              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | X              | 1              | 0              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 0   | 0                |   |
|           |                |                |                | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1   | 1                |   |

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