# SN54F381, SN74F381

## *Arithmetic Logic Units/Function Generators*

The SN54F381 and SN74F381 are arithmetic logic units (ALU)/function generators that perform eight binary arithmetic/logic operations on two 4-bit words as shown in the function table. The exclusive-OR, AND, and OR functions of the two Boolean variables are provided without the use of external circuits. In addition, the outputs can be cleared (low) or preset (high) as desired. The ‘F381 provides two cascade outputs ($\overline{P}$ and $\overline{G}$) for expansion utilizing ‘AS182 look-ahead carry generators.

### Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

### Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-38535
    - Class Q Military
    - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
    - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

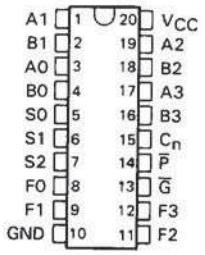
Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

*The original manufacturer’s datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. ‘Typical’ values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.*

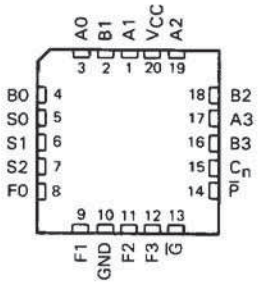
D2932, MARCH 1987–REVISED JUNE 1988

- Fully Parallel 4-Bit ALUs in 20-Pin Package
- Ideally Suited for High-Density Economical Processors
- $\overline{G}$ and $\overline{P}$ Outputs for Look-Ahead Carry Cascading
- Arithmetic and Logic Operations Selected Specifically to Simplify System Implementation:
  - A Minus B
  - B Minus A
  - A Plus B
  - and Five Other Functions
- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs
- Dependable Texas Instruments Quality and Reliability

SN54F381 . . . J PACKAGE
SN74F381 . . . DW OR N PACKAGE
(TOP VIEW)




SN54F381 . . . FK PACKAGE
(TOP VIEW)




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 | ACTIVE-LOW CARRY PROPAGATE OUTPUT |
| $\overline{G}$ | 13 | ACTIVE-LOW CARRY GENERATE OUTPUT |
| $V_{CC}$ | 20 | SUPPLY VOLTAGE |
| GND | 10 | GROUND |

FUNCTION TABLE

| SELECTION | | | ARITHMETIC/LOGIC |
|---|---|---|---|
| S2 | S1 | S0 | OPERATION |
| 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

## description

The SN54F381 and SN74F381 are arithmetic logic units (ALU)/function generators that perform eight binary arithmetic/logic operations on two 4-bit words as shown in the function table. The exclusive-OR, AND, and OR functions of the two Boolean variables are provided without the use of external circuits. In addition, the outputs can be cleared (low) or preset (high) as desired. The 'F381 provides two cascade outputs ($\overline{P}$ and $\overline{G}$) for expansion utilizing 'AS182 look-ahead carry generators.

The SN54F381 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74F381 is characterized for operation from 0°C to 70°C.

### function table

Certain differences exist in the $\overline{G}$ and $\overline{P}$ function table compared with similar parts from other technologies. No differences exist in the arithmetic modes (B minus A, A minus B, and A plus B), where these outputs perform valuable cascade functions. There are slight differences in the other modes (CLEAR, A + B, A ⊕ B, AB, and PRESET), in which these outputs are strictly "don't care." There are no functional differences between 'F381 parts built by Texas Instruments and Fairchild.

This function table is a condensed version and assumes for $A_n$ that A0, A1, A2, and A3 inputs all agree and for $B_n$ that B0, B1, B2, and B3 inputs all agree. This table is intended to point out the response of these $\overline{G}$ and $\overline{P}$ outputs in all modes of operation to facilitate incoming inspection.

FUNCTION TABLE

| ARITHMETIC/LOGIC OPERATION | INPUTS | | | | | | OUTPUTS | | | | $\overline{G}$ | $\overline{P}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S2 | S1 | S0 | $C_n$ | $A_n$ | $B_n$ | F3 | F2 | F1 | F0 | | |
| CLEAR | L | L | L | X | X | X | L | L | L | L | L | L |
| B MINUS A | L | L | H | L | L | L | H | H | H | H | H | L |
| | | | | L | L | H | H | H | H | L | 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 | H | H | H |
| | | | | H | H | H | L | L | L | L | H | L |
| 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 | H | H | H | H | L | L |
| | | | | L | H | H | H | H | H | L | H | L |
| | | | | H | L | L | L | L | L | H | H | L |
| | | | | H | L | H | H | H | H | L | H | H |
| | | | | H | H | L | H | H | H | H | L | L |
| | | | | H | H | H | L | L | L | L | H | L |
| A PLUS B | L | H | H | L | L | L | L | L | L | L | H | H |
| | | | | L | L | H | H | H | H | H | H | L |
| | | | | L | H | L | H | H | H | H | H | L |
| | | | | L | H | H | H | H | H | L | L | L |
| | | | | H | L | L | L | L | L | H | H | H |
| | | | | H | L | H | L | L | L | L | H | L |
| | | | | H | H | L | L | L | L | L | H | L |
| | | | | H | H | H | H | H | H | H | L | L |
| A ⊕ B | H | L | L | X | L | L | L | L | L | L | H | H |
| | | | | X | L | H | H | H | H | H | H | H |
| | | | | X | H | L | H | H | H | H | H | L |
| | | | | X | H | H | 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 |
| | | | | X | H | L | H | H | H | H | H | H |
| | | | | X | H | H | H | H | H | H | H | L |
| AB | H | H | L | X | L | L | L | L | L | L | L | L |
| | | | | X | L | H | L | L | L | L | H | H |
| | | | | X | H | L | L | L | L | L | L | L |
| | | | | X | 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 |
| | | | | X | H | L | H | H | H | H | H | H |
| | | | | X | H | H | H | H | H | H | H | L |



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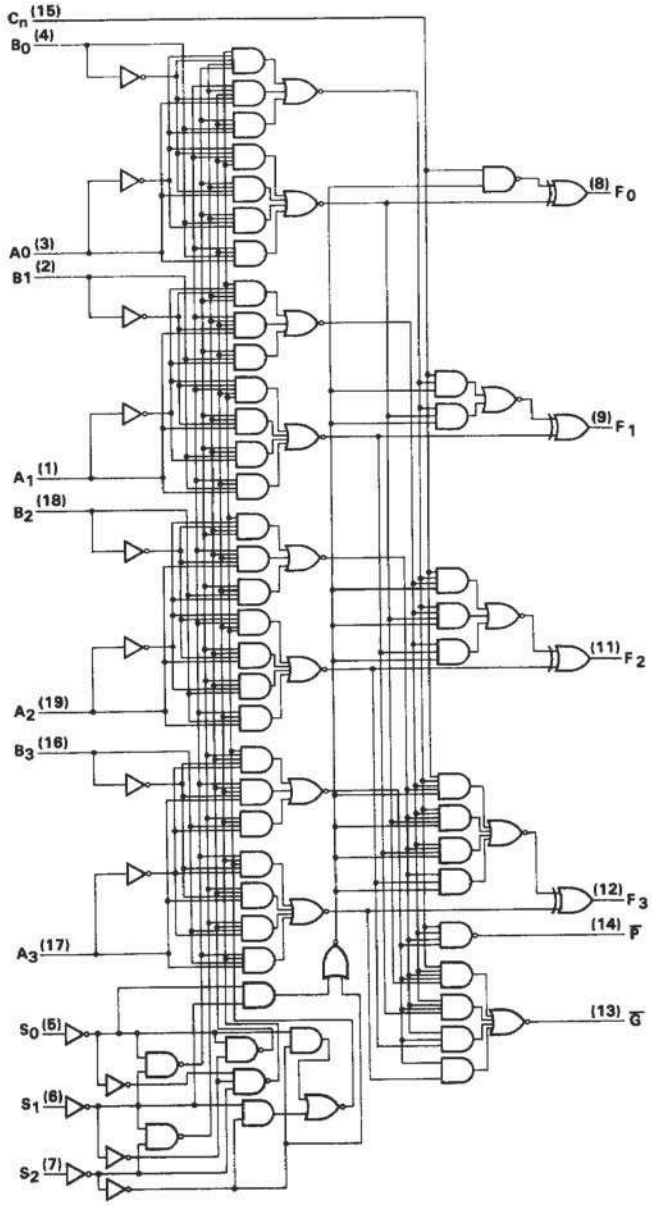
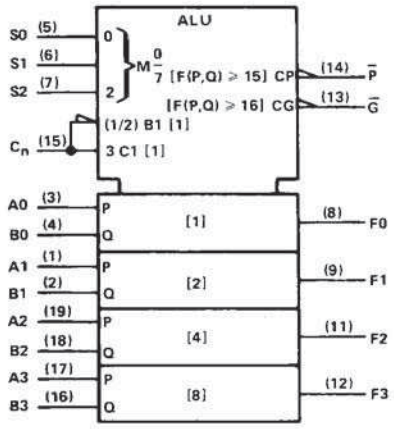
**logic diagram (positive logic)**



### logic symbol†




†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC}$ . . . . . −0.5 V to 7 V
Input voltage‡ . . . . . −1.2 V to 7 V
Input current . . . . . −30 mA to 5 mA
Voltage applied to any output in the high state . . . . . −0.5 V to $V_{CC}$
Current into any output in the low state . . . . . 40 mA
Operating free-air temperature range: SN54F381 . . . . . −55°C to 125°C
SN74F381 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

‡The input voltage ratings may be exceeded provided the input current ratings are observed.

### recommended operating conditions

| | | SN54F381 | | | SN74F381 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | 4.5 | 5 | 5.5 | 4.5 | 5 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | 0.8 | | | 0.8 | V |
| $I_{IK}$ | Input clamp current | | | −18 | | | −18 | mA |
| $I_{OH}$ | High-level output current | | | −1 | | | −1 | mA |
| $I_{OL}$ | Low-level output current | | | 20 | | | 20 | mA |
| $T_A$ | Operating free-air temperature | −55 | | 125 | 0 | | 70 | °C |

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER | TEST CONDITIONS | | SN54F381 | | | SN74F381 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $V_{IK}$ | $V_{CC}$ = 4.5 V, $I_I$ = −18 mA | | | | −1.2 | | | −1.2 | V |
| $V_{OH}$ | $V_{CC}$ = 4.75 V, $I_{OH}$ = −1 mA | | | | | 2.7 | | | V |
| | $V_{CC}$ = 4.5 V, $I_{OH}$ = −1 mA | | 2.5 | 3.4 | | 2.5 | 3.4 | | |
| $V_{OL}$ | $V_{CC}$ = 4.5 V, $I_{OL}$ = 20 mA | | | 0.3 | 0.5 | | 0.3 | 0.5 | V |
| $I_I$ | $V_{CC}$ = 5.5 V, $V_I$ = 7 V | | | | 0.1 | | | 0.1 | mA |
| $I_{IH}$ | $V_{CC}$ = 5.5 V, $V_I$ = 2.7 V | | | | 20 | | | 20 | μA |
| $I_{IL}$ | $V_{CC}$ = 5.5 V, $V_I$ = 0.5 V | Any A or B | | | −2.4 | | | −2.4 | mA |
| | | Any S | | | −0.6 | | | −0.6 | |
| | | $C_n$ | | | −2.4 | | | −2.4 | |
| $I_{OS}$‡ | $V_{CC}$ = 5.5 V, $V_O$ = 0 | | −60 | | −150 | −60 | | −150 | mA |
| $I_{CC}$ | $V_{CC}$ = 5.5 V, See Note 1 | | | 59 | 89 | | 59 | 89 | mA |

**switching characteristics (see Note 2)**

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ = 5 V, $C_L$ = 50 pF, $R_L$ = 500 Ω, $T_A$ = 25°C | | | $V_{CC}$ = 4.5 V to 5.5 V, $C_L$ = 50 pF, $R_L$ = 500 Ω, $T_A$ = MIN to MAX§ | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 'F381 | | | SN54F381 | | SN74F381 | | |
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{PLH}$ | $C_n$ | Any F | 2.5 | 5.1 | 8.5 | 3 | 15 | 2.5 | 9.5 | ns |
| $t_{PHL}$ | | | 2 | 4.3 | 7 | 2.5 | 12 | 2 | 7.5 | |
| $t_{PLH}$ | Any A or B | Any F | 3 | 6.7 | 11.5 | 3.5 | 19 | 3 | 12.5 | ns |
| $t_{PHL}$ | | | 2.5 | 5.8 | 9.5 | 3 | 16 | 2.5 | 10 | |
| $t_{PLH}$ | S0, S1, S2 | Any F | 3.5 | 8.1 | 15 | 3 | 16 | 3.5 | 16 | ns |
| $t_{PHL}$ | | | 3.5 | 7.3 | 14 | 3 | 16 | 3.5 | 15 | |
| $t_{PLH}$ | Any A or B | $\overline{G}$ | 2.5 | 5.2 | 9 | 3 | 13 | 2.5 | 10 | ns |
| $t_{PHL}$ | | | 2 | 4.6 | 7.5 | 3 | 14 | 2 | 7.5 | |
| $t_{PLH}$ | Any A or B | $\overline{P}$ | 2.5 | 5 | 9 | 3 | 15 | 2.5 | 10 | ns |
| $t_{PHL}$ | | | 3.5 | 6 | 9 | 3 | 13 | 3.5 | 9.5 | |
| $t_{PLH}$ | S0, S1, S2 | $\overline{G}$ or $\overline{P}$ | 4.5 | 7.4 | 12.5 | 3 | 15 | 4.5 | 13.5 | ns |
| $t_{PHL}$ | | | 3 | 6 | 13 | 3 | 19 | 3 | 13.5 | |

† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.
§ For conditions shown as MIN or MAX, use the appropriate value specified under Recommended Operating Conditions.
NOTES: 1. $I_{CC}$ is measured with all outputs open, S0, S1 and S2 grounded, and all other inputs at 4.5 V.
2. Load circuits and waveforms are shown in Section 1.