

SN54LS381A, SN54S381, SN74LS381A, SN54LS382A, SN74LS382A, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

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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 |
| \bar{P} ('LS381A 'S381 ONLY) | 14 | ACTIVE-LOW CARRY PROPAGATE OUTPUT |
| \bar{G} ('LS381A 'S381 ONLY) | 13 | ACTIVE-LOW CARRY GENERATE OUTPUT |
| $C_n + 4$ ('LS382A ONLY) | 14 | RIPPLE-CARRY OUTPUT |
| OVR ('LS382A ONLY) | 13 | OVERFLOW OUTPUT |
| VCC | 20 | SUPPLY VOLTAGE |
| GND | 10 | GROUND |

- Fully Parallel 4-Bit ALUs in 20-Pin Package for 0.300-Inch Row Spacing
- Ideally Suited for High-Density Economical Processors
- 'LS381A and 'S381 Feature \bar{G} and \bar{P} Outputs for Look-Ahead Carry Cascading
- 'LS382A Features Ripple Carry ($C_n + 4$) and Overflow (OVR) Outputs
- Arithmetic and Logic Operations Selected Specifically to Simplify System Implementation:
 - A Minus B
 - B Minus A
 - A Plus B
 - and Five Other Functions

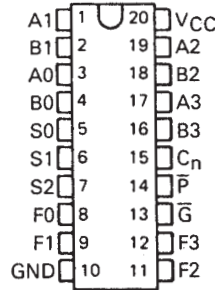
description

The 'LS381A, 'S381 and 'LS382A are low-power Schottky and Schottky TTL arithmetic logic units (ALUs)/function generators that perform eight binary arithmetic/logic operations on two 4-bit words as shown in the function table. The exclusive-OR, AND, or OR function of the two Boolean variables is provided without the use of external circuitry. Also, the outputs can be cleared (low) or preset (high) as desired. The 'LS381A and 'S381 provide two cascade outputs (\bar{P} and \bar{G}) for expansion utilizing SN54S182/SN74S182 look-ahead carry generators. The 'LS382 provides a $C_n + 4$ output to ripple the carry to the C_n input of the next stage. The 'LS382A detects and indicates two's complement overflow condition via the OVR output. The overflow output is logically equivalent to $C_n + 3 \oplus C_n + 4$. When the 'LS382A is cascaded to handle word lengths longer than four bits in length, only the most significant overflow (OVR) output is used.

The SN54' family is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74' family is characterized for operation from 0°C to 70°C .

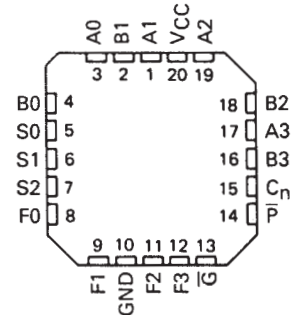
SN54LS381A, SN54S381
... J OR W PACKAGE
SN74LS381A, SN74S381
... DW OR N PACKAGE

(TOP VIEW)



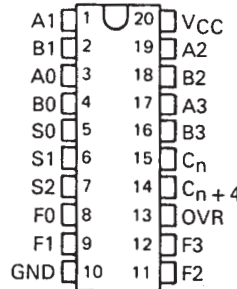
SN54LS381A, SN54S381
... FK PACKAGE

(TOP VIEW)



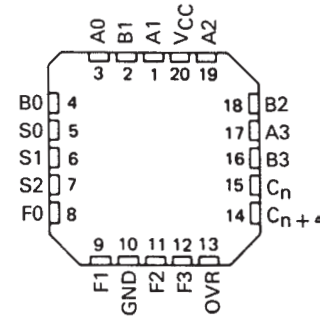
SN54LS382A ...
J OR W PACKAGE
SN74LS382A ...
DW OR N PACKAGE

(TOP VIEW)



SN54LS382A ... FK PACKAGE

(TOP VIEW)



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 | $A \oplus B$ |
| H | L | H | $A + B$ |
| H | H | L | AB |
| H | H | H | PRESET |

H = high level, L = low level

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function table

Certain differences exist in the \overline{G} , \overline{P} ('LS381A, 'S381) and OVR, C_{n+4} ('LS382A) function table compared with similar parts from other technologies and other vendors. 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, $A + B$, $A \oplus B$, AB, and PRESET), where these outputs are strictly "don't care".

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} , \overline{P} ('LS381A, 'S381) and OVR, C_{n+4} ('LS382A) outputs in all modes of operation to facilitate incoming inspection.

FUNCTION TABLE

| ARITHMETIC/LOGIC OPERATION | INPUTS | | | | | | OUTPUTS | | | | ('LS381A, 'S381) | | ('LS382A) | | |
|-------------------------------|--------|----|----|-------|-------|-------|---------|----|----|----|------------------|----------------|-----------|-----------|---|
| | S2 | S1 | S0 | C_n | A_n | B_n | F3 | F2 | F1 | F0 | \overline{G} | \overline{P} | OVR | C_{n+4} | |
| CLEAR | L | L | L | X | X | X | L | L | L | L | H | H | L | L | |
| B MINUS A | L | L | H | L | L | L | H | H | H | H | H | L | L | L | |
| | | | | L | L | H | H | H | H | L | L | H | H | L | H |
| | | | | L | H | L | L | L | L | L | L | H | H | L | L |
| | | | | L | H | H | H | H | H | H | H | H | L | L | L |
| | | | | H | L | L | L | L | L | L | L | H | L | L | H |
| | | | | H | L | H | H | H | H | H | H | L | H | L | H |
| | | | | H | H | L | L | L | L | L | L | H | H | L | L |
| | | | | H | H | H | L | L | L | L | L | H | L | L | H |
| A MINUS B | L | H | L | L | L | L | H | H | H | H | H | L | L | L | |
| | | | | L | L | H | L | L | L | L | H | H | L | L | |
| | | | | L | H | L | H | H | H | L | L | L | H | L | H |
| | | | | L | H | H | H | H | H | H | H | H | L | L | L |
| | | | | H | L | L | L | L | L | L | L | L | H | L | L |
| | | | | H | L | H | L | L | L | L | L | H | H | L | L |
| | | | | H | H | L | H | H | H | H | H | L | H | L | H |
| | | | | H | H | H | L | L | L | L | L | H | L | L | H |
| A PLUS B | L | H | H | L | L | L | L | L | L | L | H | H | L | L | |
| | | | | L | L | H | H | H | H | H | H | L | L | L | |
| | | | | L | H | L | H | H | H | H | H | H | L | L | |
| | | | | L | H | H | H | H | H | L | L | H | H | L | H |
| | | | | H | L | L | L | L | L | L | L | H | L | L | L |
| | | | | H | L | H | L | L | L | L | L | H | L | L | H |
| | | | | H | H | L | L | L | L | L | L | H | L | L | H |
| | | | | H | H | H | L | L | L | L | L | H | L | L | H |
| $A \oplus B$ | H | L | L | X | L | L | L | L | L | L | H | H | L | L | |
| | | | | L | L | H | H | H | H | H | H | L | L | L | |
| | | | | H | L | H | H | H | H | H | H | L | H | H | |
| | | | | L | H | L | H | H | H | H | H | L | L | L | |
| | | | | H | H | L | L | L | L | L | L | H | L | H | |
| X | H | H | L | L | L | L | L | H | H | L | L | | | | |
| A + B | H | L | H | X | L | L | L | L | L | L | H | H | L | L | |
| | | | | L | L | H | H | H | H | H | H | L | L | L | |
| | | | | H | L | H | H | H | H | H | H | L | H | H | |
| | | | | L | H | L | H | H | H | H | H | L | L | L | |
| | | | | L | H | H | H | H | H | H | H | L | L | L | |
| H | H | H | L | L | L | L | L | H | L | H | | | | | |
| AB | H | H | L | X | L | L | L | L | L | L | H | H | L | L | |
| | | | | X | L | H | L | L | L | L | H | H | L | L | |
| | | | | L | H | L | L | L | L | L | H | L | L | L | |
| | | | | L | H | H | H | H | H | H | H | L | L | L | |
| H | H | H | L | L | L | L | L | H | L | H | | | | | |
| PRESET | H | H | H | L | X | X | H | H | H | H | H | L | L | L | |
| | | | | H | X | X | H | H | H | H | H | L | H | H | |

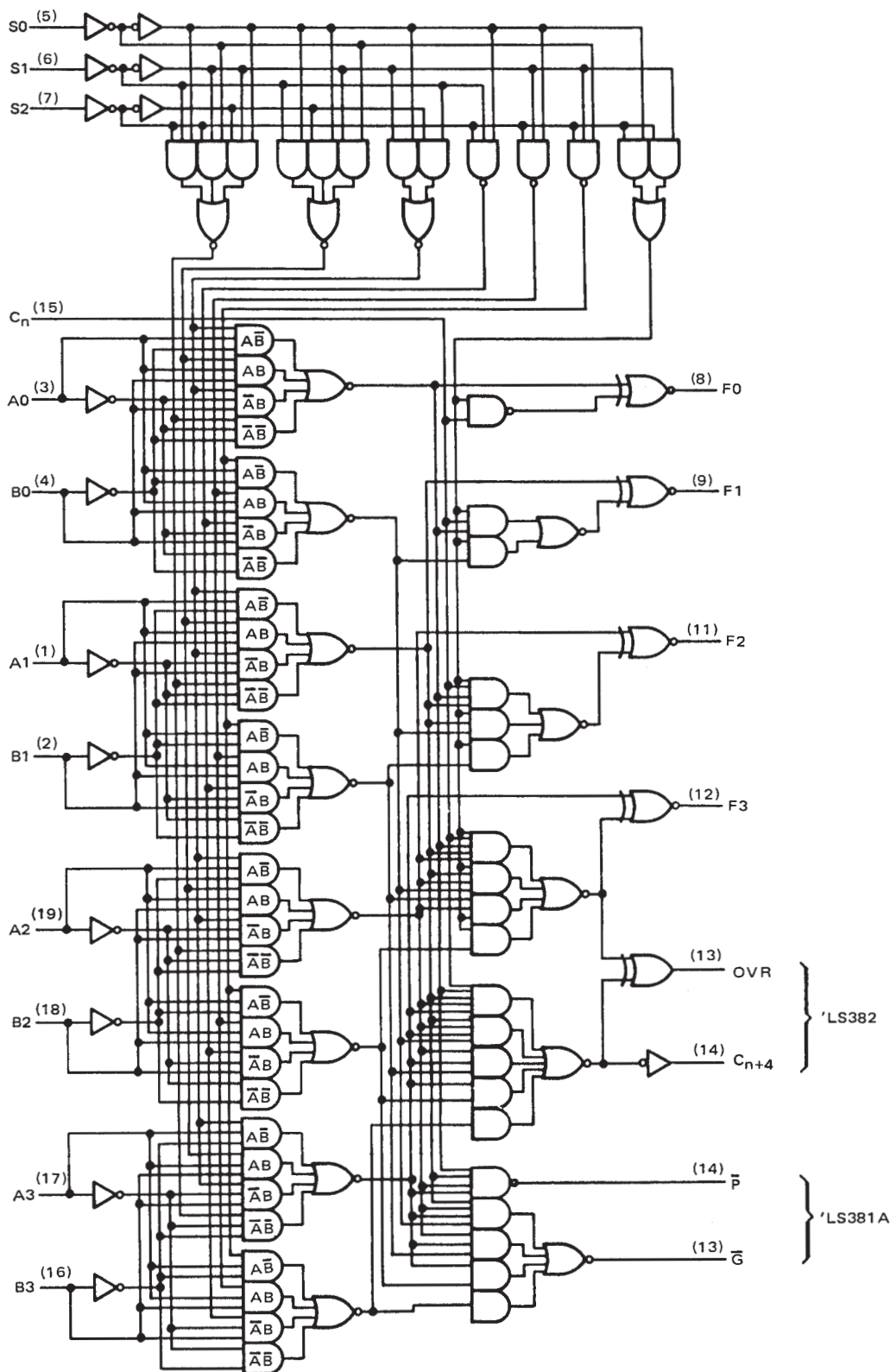


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logic diagram (positive logic)

'LS381A, 'LS382A



Pin numbers shown are for DW, J, N, and W packages.

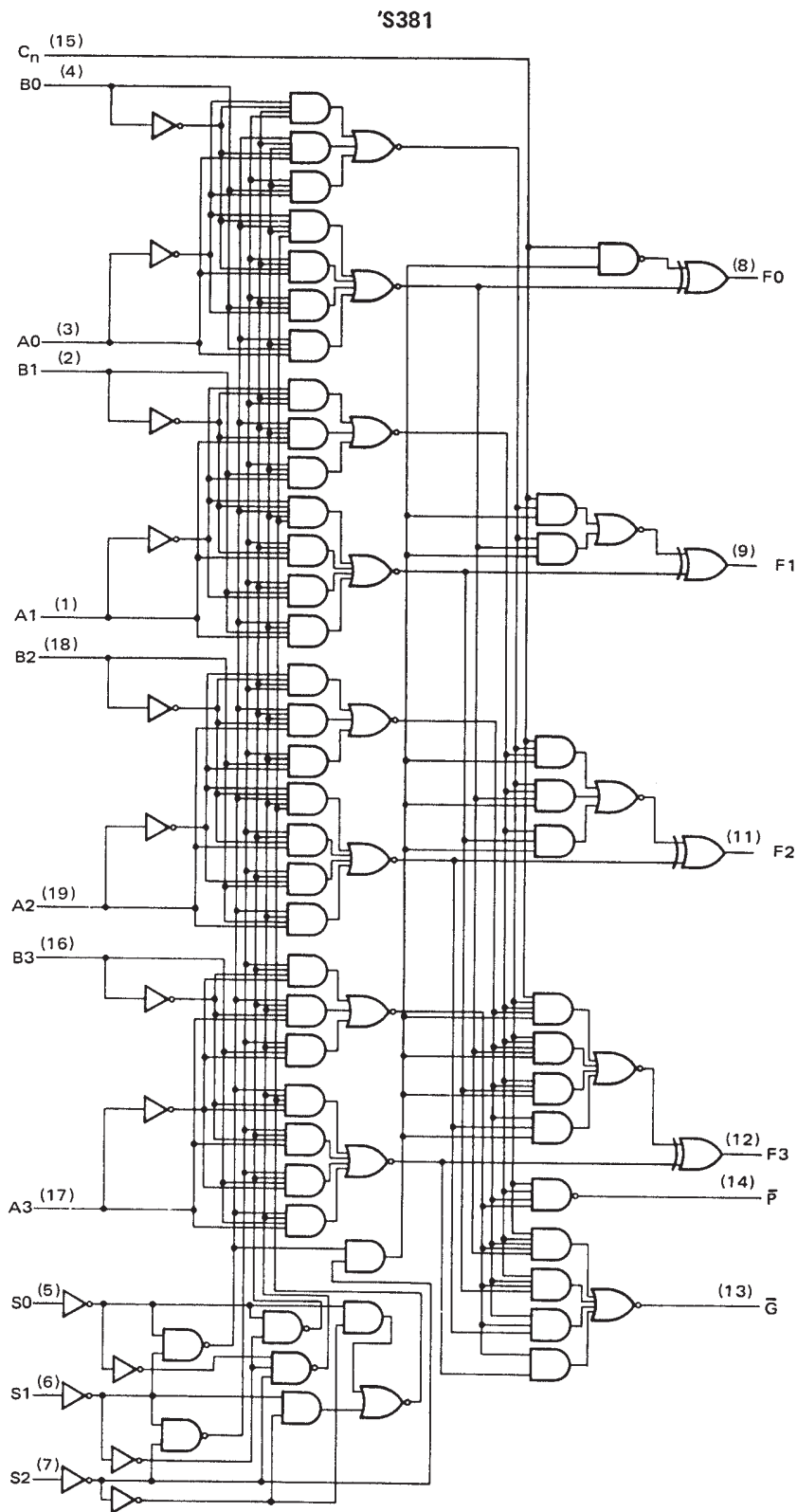


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logic diagram and schematics of inputs and outputs



²Pin numbers shown are for DW, J, N, and W packages.

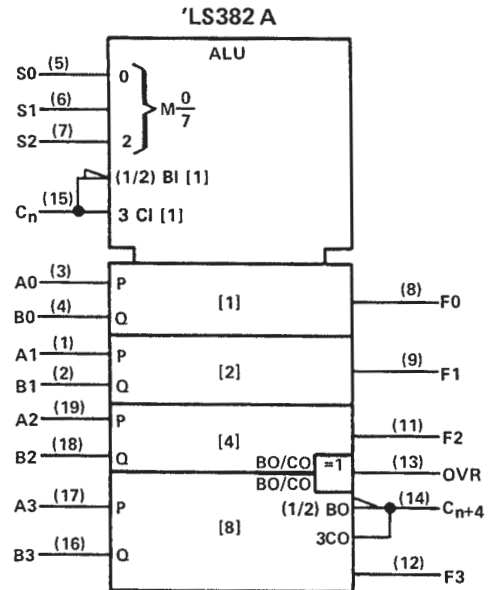
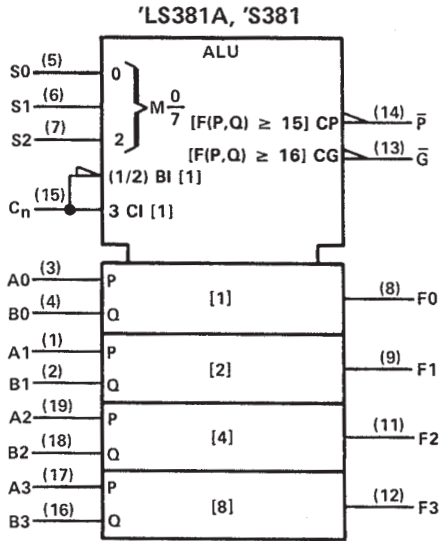


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logic symbols †

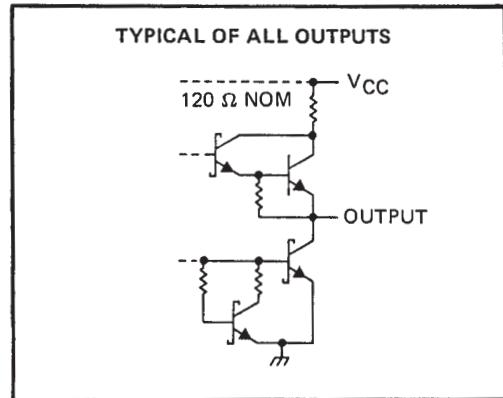
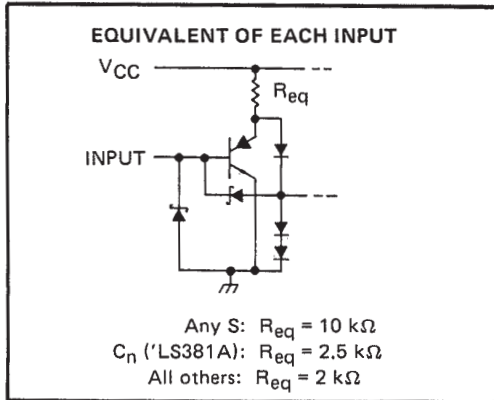


†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

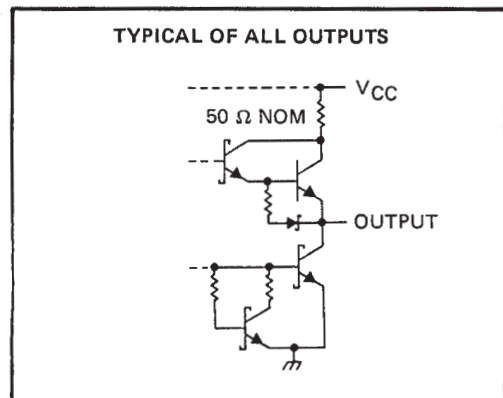
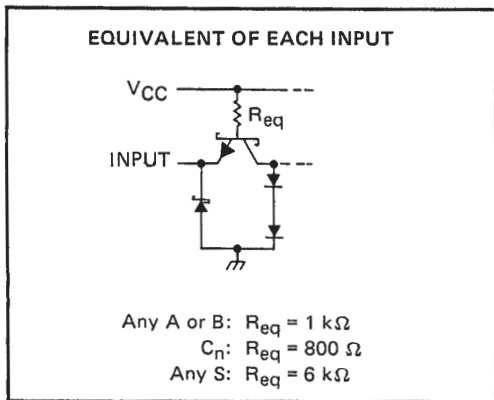
Pin numbers shown are for DW, J, N, and W packages.

schematics of inputs and outputs

'LS381, 'LS382A



'S381



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

| | |
|--|----------------|
| Supply voltage, V_{CC} (See Note 1) | 7 V |
| Input voltage | 7 V |
| Operating free-air temperature range: SN54LS381A, SN54LS382A | -55°C to 125°C |
| SN74LS381A, SN74LS382A | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

NOTE 1: Voltage values are with respect to the network ground terminal.

recommended operating conditions

| | SN54LS' | | | SN74LS' | | | UNIT |
|--------------------------------------|-----------------------------|-----|------|---------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V_{IH} High-level input voltage | 2 | | | 2 | | | V |
| V_{IL} Low-level input voltage | | | 0.7 | | | 0.8 | V |
| I_{OH} High-level output current | | | -0.4 | | | -0.4 | mA |
| I_{OL} Low-level output current | \bar{G} output of 'LS381A | | 16 | | | 16 | mA |
| | All other outputs | | 4 | | | 8 | |
| 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† | SN54LS' | | SN74LS' | | UNIT | | |
|-----------|--|--|--------------------------|---------|-----|------|---------------|-----|
| | | MIN | TYP‡ | MAX | MIN | | TYP‡ | MAX |
| V_{IK} | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | | | -1.5 | | -1.5 | V | |
| V_{OH} | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}, I_{OH} = -0.4 \text{ mA}$ | 2.5 | 3.4 | | 2.7 | 3.4 | V | |
| V_{OL} | \bar{G} ('LS381A) | | 0.47 | 0.7 | | 0.47 | 0.7 | V |
| | Other outputs | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}$ | $I_{OL} = 16 \text{ mA}$ | | | 0.25 | 0.4 | |
| | | | $I_{OL} = 4 \text{ mA}$ | | | | 0.35 | |
| I_I | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$ | | | 0.1 | | 0.1 | mA | |
| | | | | | | | | |
| I_{IH} | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | Any S | | 20 | | 20 | μA | |
| | | Any A or B | | 100 | | 100 | | |
| | | C_n ('LS381A) | | 80 | | 80 | | |
| | | C_n ('LS382A) | | 100 | | 100 | | |
| I_{IL} | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | Any S | | -0.2 | | -0.2 | mA | |
| | | Any A or B | | -1 | | -1 | | |
| | | C_n ('LS381A) | | -0.8 | | -0.8 | | |
| | | C_n ('LS382A) | | -0.8 | | -0.8 | | |
| $I_{OS}§$ | $V_{CC} = \text{MAX}$ | -20 | | -100 | -20 | | -100 | mA |
| I_{CC} | $V_{CC} = \text{MAX},$ All inputs grounded, outputs open | | 35 | 65 | | 35 | 65 | mA |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.



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switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (see note 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | 'LS381A | | | 'LS382 | | | UNIT |
|------------------|--|----------------------------|--|---------|-----|-----|--------|-----|-----|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t _{PLH} | C _n | Any F | $R_L = 2\text{ k}\Omega, \quad C_L = 15\text{ pF}$ | 18 | | 27 | 18 | | 27 | ns |
| t _{PHL} | | | | 14 | | 21 | 14 | | 21 | |
| t _{PLH} | Any A or B | \bar{G} | | 20 | | 30 | | | | ns |
| t _{PHL} | | | | 21 | | 33 | | | | |
| t _{PLH} | Any A or B | \bar{P} | | 21 | | 33 | | | | ns |
| t _{PHL} | | | | 23 | | 33 | | | | |
| t _{PLH} | A _i or B _i | F _i | | 20 | | 30 | 20 | | 30 | ns |
| t _{PHL} | | | | 15 | | 23 | 15 | | 23 | |
| t _{PLH} | S ₀ , S ₁ , S ₂ | F _i | | 35 | | 53 | 35 | | 53 | ns |
| t _{PHL} | | | | 34 | | 51 | 34 | | 51 | |
| t _{PLH} | S ₀ , S ₁ , S ₂ | \bar{G} or \bar{P} | | 31 | | 47 | | | | ns |
| t _{PHL} | | | | 32 | | 48 | | | | |
| t _{PLH} | Any A or B | C _{n+4} | | | | | 28 | | 42 | ns |
| t _{PHL} | | | | | | | 26 | | 39 | |
| t _{PLH} | Any A or B | OVR | | | | | 23 | | 35 | ns |
| t _{PHL} | | | | | | | 27 | | 41 | |
| t _{PLH} | S ₀ , S ₁ , S ₂ | C _{n+4} or OVR | | | | | 38 | | 57 | ns |
| t _{PHL} | | | | | | | 36 | | 54 | |
| t _{PLH} | C _n | OVR | | | | | 10 | | 15 | ns |
| t _{PHL} | | | | | | | 13 | | 23 | |
| t _{PLH} | C _n | C _{n+4} | | | | 13 | | 21 | ns | |
| t _{PHL} | | | | | | 11 | | 20 | | |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



SN54LS381A, SN54S381, SN74LS381A, SN54LS382A, SN74LS382A, SN74S381 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS

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

| | |
|--|----------------|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Input voltage | 5.5 V |
| Interemitter voltage (see Note 2) | 5.5 V |
| Operating free-air temperature range: SN54S381 | -55°C to 125°C |
| SN74S381 | 0°C to 70°C |
| Storage free-air temperature | -65°C to 150°C |

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. For this circuit, this rating applies to each A input in conjunction with its respective B input; for example A0 with B0, etc.

recommended operating conditions

| | SN54S381 | | | SN74S381 | | | UNIT |
|---------------------------------------|----------|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output current, I_{OH} | | | -1 | | | -1 | mA |
| Low-level output current, I_{OL} | | | 20 | | | 20 | mA |
| Operating free-air temperature, T_A | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | | TEST CONDITIONS† | MIN | TYP‡ | MAX | UNIT |
|-----------|--|--|--|------|------|---------------|
| V_{IH} | High-level input voltage | | 2 | | | V |
| V_{IL} | Low-level input voltage | | | | 0.8 | V |
| V_{IK} | Input clamp voltage | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | | | -1.2 | V |
| V_{OH} | High-level output voltage | SN54S381 | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ | 2.4 | 3.4 | V |
| | | SN74S381 | $V_{IL} = 0.8 \text{ V}, I_{OH} = -1 \text{ mA}$ | 2.7 | 3.4 | |
| V_{OL} | Low-level output voltage | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, I_{OL} = 20 \text{ mA}$ | | | 0.5 | V |
| I_I | Input current at maximum input voltage | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$ | | | 1 | mA |
| I_{IH} | High-level input current | Any S input | | | 50 | μA |
| | | C_n | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | | 250 | |
| | | All others | | | 200 | |
| I_{IL} | Low-level input current | Any S input | | | -2 | mA |
| | | C_n | $V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$ | | -8 | |
| | | All others | | | -6 | |
| I_{OS} | Short-circuit output current§ | $V_{CC} = \text{MAX}$ | -40 | | -100 | mA |
| I_{CC} | Supply current | $V_{CC} = \text{MAX}$ | | 105 | 160 | mA |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time.

switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|----------------|-------------|--|-----|-----|-----|------|
| t_{PLH} | C_n | Any F | $C_L = 15 \text{ pF}, R_L = 280 \Omega,$ See Note 3 | 10 | 17 | ns | |
| t_{PHL} | | | | 10 | 17 | | |
| t_{PLH} | Any A or B | \bar{G} | | 12 | 20 | ns | |
| t_{PHL} | | | | 12 | 20 | | |
| t_{PLH} | Any A or B | \bar{P} | | 11 | 18 | ns | |
| t_{PHL} | | | | 11 | 18 | | |
| t_{PLH} | A_i or B_i | F_i | | 18 | 27 | ns | |
| t_{PHL} | | | | 16 | 25 | | |
| t_{PLH} | Any S | Any | | 18 | 30 | ns | |
| t_{PHL} | | | | 18 | 30 | | |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



IMPORTANT NOTICE

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