# Quad serial adder/subtractor 74F385

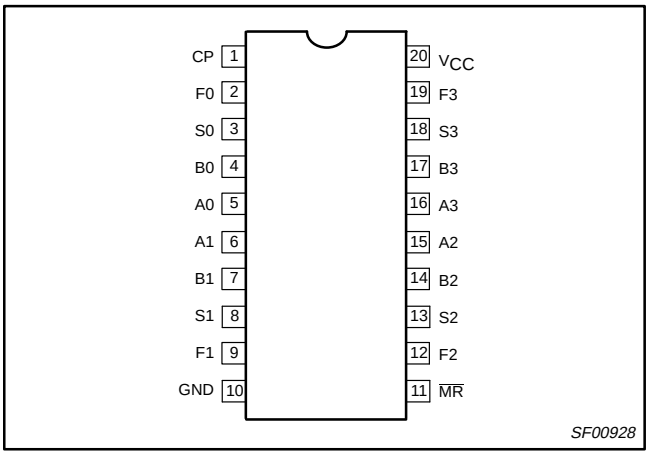
## FEATURES

- Four independent adders/subtractors
- Two's complement arithmetic
- Synchronous operation
- Common Clear and Clock
- 74F385 is designed for use with serial multipliers in implementing digital filters and butterfly networks in fast Fourier transforms

## DESCRIPTION

The 74F385 contains four independent adder/subtractor elements with common Clock and Master Reset. Each adder/subtractor contains a sum flop-flop and a carry flip-flop for synchronous operations. Flip-flop state changes occur on the rising edge of the Clock Pulse (CP) input signal. The Select (S) input should be Low for the Add (A plus B) mode and High for the Subtract (A minus B) mode. A Low signal on the asynchronous Master Reset ($\overline{MR}$) input clears the sum flip-flop and resets the Carry flip-flop to zero in the Add mode or presets it to one in the Subtract mode.

## PIN CONFIGURATION




| TYPE | TYPICAL $f_{MAX}$ | TYPICAL SUPPLY CURRENT (TOTAL) |
|---|---|---|
| 74F385 | 140 MHz | 55mA |

## ORDERING INFORMATION

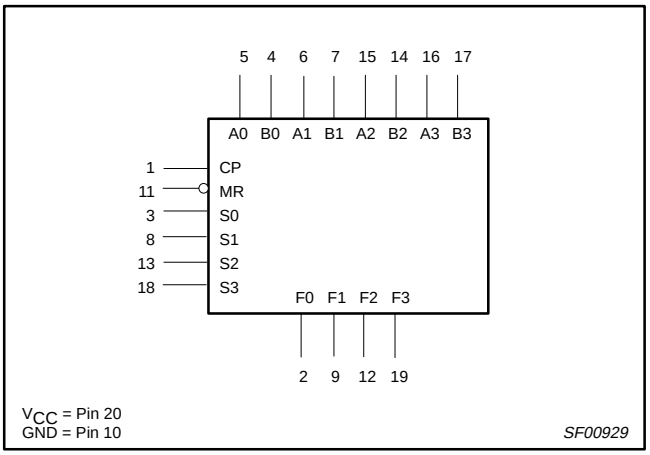
| DESCRIPTION | COMMERCIAL RANGE $V_{CC}$ = 5V ±10%, $T_{amb}$ = 0°C to +70°C |
|---|---|
| 20-pin plastic DIP | N74F385N |
| 20-pin plastic SO | N74F385D |

## INPUT AND OUTPUT LOADING AND FAN OUT TABLE

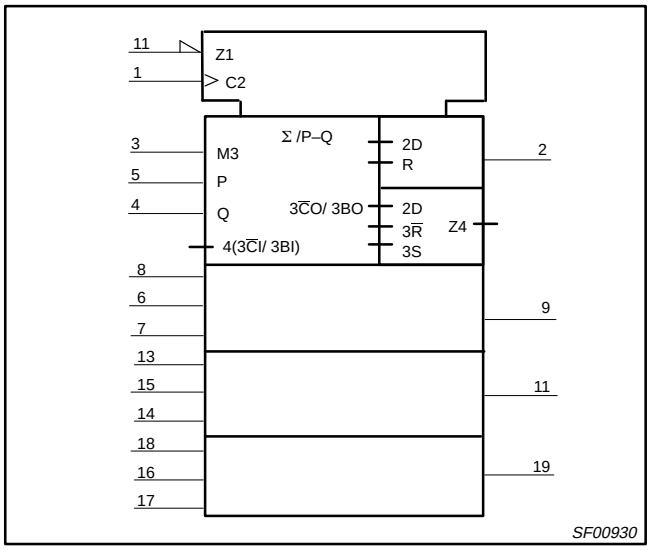
| PINS | DESCRIPTION | 74F (U.L.) HIGH/LOW | LOAD VALUE HIGH/LOW |
|---|---|---|---|
| A0 – A3 | A operand inputs | 1.0/1.0 | 20µA/0.6mA |
| B0 – B3 | B operand inputs | 1.0/1.0 | 20µA/0.6mA |
| S0 – S3 | Function select inputs | 1.0/1.0 | 20µA/0.6mA |
| CP | Clock pulse input (active rising edge) | 1.0/1.0 | 20µA/0.6mA |
| $\overline{MR}$ | Asynchronous Master Reset input (active Low) | 1.0/1.0 | 20µA/0.6mA |
| F0–F3 | Sum or difference outputs | 50/33 | 1.0mA/20mA |

**NOTE:**
One (1.0) FAST unit load is defined as: 20µA in the High state and 0.6mA in the Low state.

## LOGIC SYMBOL




## IEC/IEEE SYMBOL

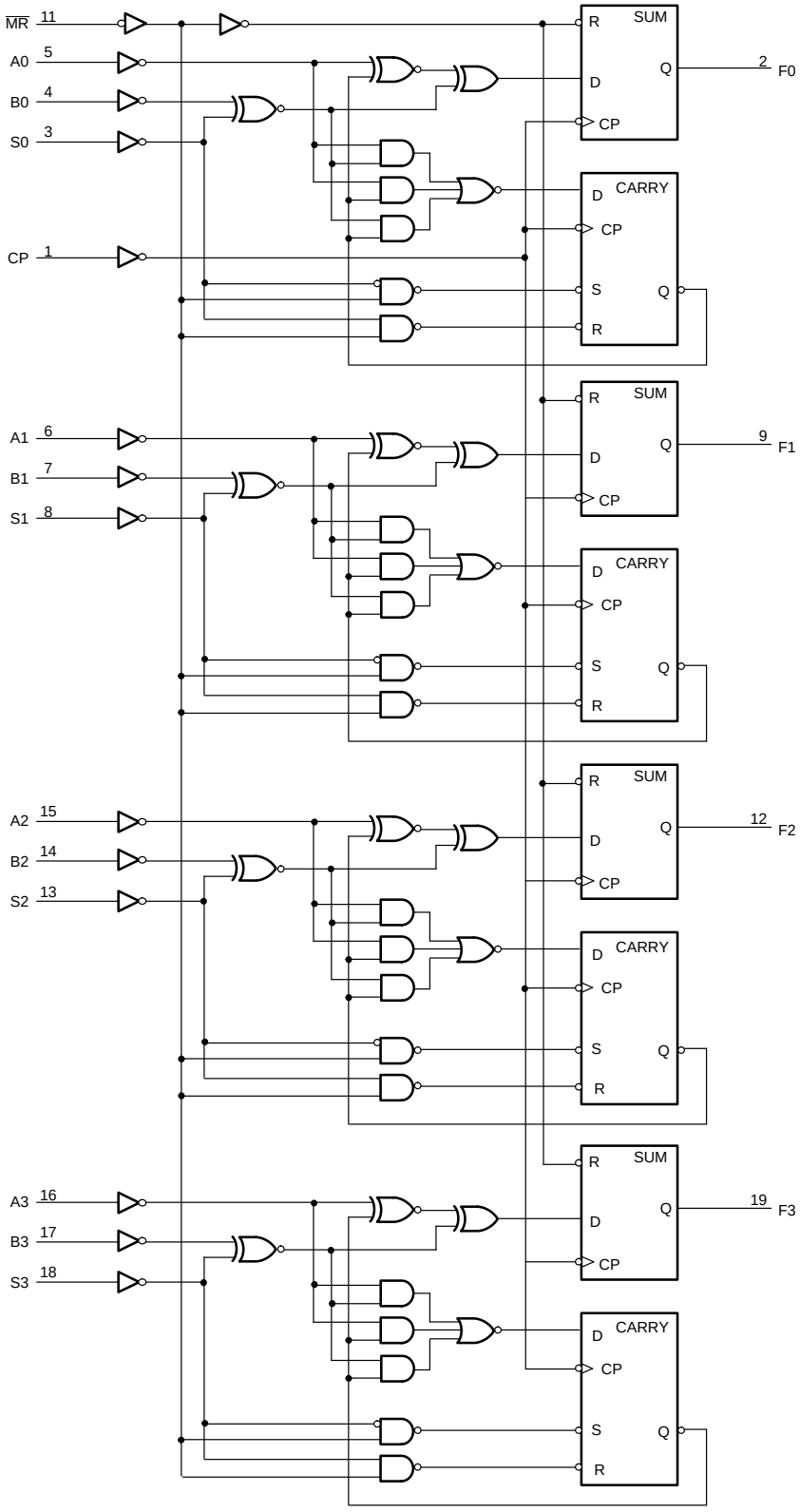



## FUNCTION TABLE

| INPUTS | | | | CARRY FLIP-FLOP STATE | | OUTPUTS | OPERATING MODE |
|---|---|---|---|---|---|---|---|
| $\overline{MR}$ | S | A | B | Before↑ | After↑ | F | |
| L | L | X | X | L | L | L | Clear |
| L | H | X | X | H | H | L | |
| H | L | L | L | L | L | L | Add |
| H | L | L | L | H | L | H | |
| H | L | L | H | L | L | H | |
| H | L | L | H | H | H | L | |
| H | L | H | L | L | L | H | |
| H | L | H | L | H | H | L | |
| H | L | H | H | L | H | L | |
| H | L | H | H | H | H | H | |
| H | H | L | L | L | L | H | Subtract |
| H | H | L | L | H | H | L | |
| H | H | L | H | L | L | L | |
| H | H | L | H | H | L | H | |
| H | H | H | L | L | H | L | |
| H | H | H | L | H | H | H | |
| H | H | H | H | L | L | H | |
| H | H | H | H | H | H | L | |

H = High voltage level
L = Low voltage level
X = Don't care
↑ = Low-to-High Clock transition

## LOGIC DIAGRAM




$V_{CC}$ = Pin 20
GND = Pin 10

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## ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free-air temperature range.)

| SYMBOL | PARAMETER | RATING | UNIT |
|---|---|---|---|
| $V_{CC}$ | Supply voltage | –0.5 to +7.0 | V |
| $V_{IN}$ | Input voltage | –0.5 to +7.0 | V |
| $I_{IN}$ | Input current | –30 to +5 | mA |
| $V_{OUT}$ | Voltage applied to output in High output state | –0.5 to $V_{CC}$ | V |
| $I_{OUT}$ | Current applied to output in Low output state | 40 | mA |
| $T_{amb}$ | Operating free-air temperature range | 0 to +70 | °C |
| $T_{stg}$ | Storage temperature | –65 to +150 | °C |

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARMETER | LIMITS | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | 4.5 | 5.0 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | 2.0 | | | V |
| $V_{IL}$ | Low-level input voltage | | | 0.8 | V |
| $I_{IK}$ | Input clamp current | | | –18 | mA |
| $I_{OH}$ | High-level output current | | | –1 | mA |
| $I_{OL}$ | Low-level output current | | | 20 | mA |
| $T_{amb}$ | Operating free-air temperature range | 0 | | 70 | °C |

## DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

| SYMBOL | PARAMETER | TEST CONDITIONS[1] | | LIMITS | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP[2] | MAX | |
| $V_{OH}$ | High-level output voltage | $V_{CC}$ = MIN, $V_{IL}$ = MAX, | ±10%$V_{CC}$ | 2.5 | | | V |
| | | $V_{IH}$ = MIN, $I_{OH}$ = MAX | ±5%$V_{CC}$ | 2.7 | 3.4 | | V |
| $V_{OL}$ | Low-level output voltage | $V_{CC}$ = MIN, $V_{IL}$ = MAX, | ±10%$V_{CC}$ | | 0.35 | 0.50 | V |
| | | $V_{IH}$ = MIN, $I_{OL}$ = MAX | ±5%$V_{CC}$ | | 0.35 | 0.50 | V |
| $V_{IK}$ | Input clamp voltage | $V_{CC}$ = MIN, $I_I$ = $I_{IK}$ | | | –0.73 | –1.2 | V |
| $I_I$ | Input current at maximum input voltage | $V_{CC}$ = MAX, $V_I$ = 7.0V | | | | 100 | µA |
| $I_{IH}$ | High-level input current | $V_{CC}$ = MAX, $V_I$ = 2.7V | | | | 20 | µA |
| $I_{IL}$ | Low-level input current | $V_{CC}$ = MAX, $V_I$ = 0.5V | | | | –20 | µA |
| $I_{OS}$ | Short-circuit output current[3] | $V_{CC}$ = MAX | | –60 | | –150 | mA |
| $I_{CC}$ | Supply current (total) | $V_{CC}$ = MAX | | | 55 | 80 | mA |

**Notes:**

1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at $V_{CC}$ = 5V, $T_{amb}$ = 25°C.
3. Not more than one output should be shorted at a time. For testing $I_{OS}$, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, $I_{OS}$ tests should be performed last.

## AC ELECTRICAL CHARACTERISTICS

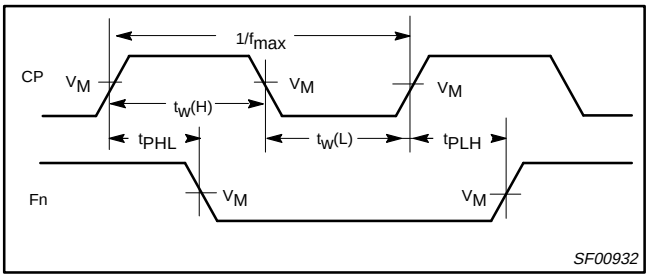
| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | $T_{amb}$ = +25°C<br>$V_{CC}$ = +5.0V<br>$C_L$ = 50pF, $R_L$ = 500Ω | | | $T_{amb}$ = 0°C to +70°C<br>$V_{CC}$ = +5.0V ± 10%<br>$C_L$ = 50pF, $R_L$ = 500Ω | | |
| | | | MIN | TYP | MAX | MIN | MAX | |
| $f_{MAX}$ | Maximum clock frequency | Waveform 1 | 105 | 140 | | 90 | | MHz |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay,<br>Cn to Fn | Waveform 1 | 3.0<br>3.5 | 5.0<br>5.5 | 8.0<br>9.0 | 2.5<br>3.5 | 9.0<br>10.0 | ns |
| $t_{PLH}$ | Propagation delay, $\overline{MR}$ to Fn | Waveform 2 | 4.0 | 6.5 | 9.5 | 4.0 | 10.5 | ns |

## AC SETUP REQUIREMENTS

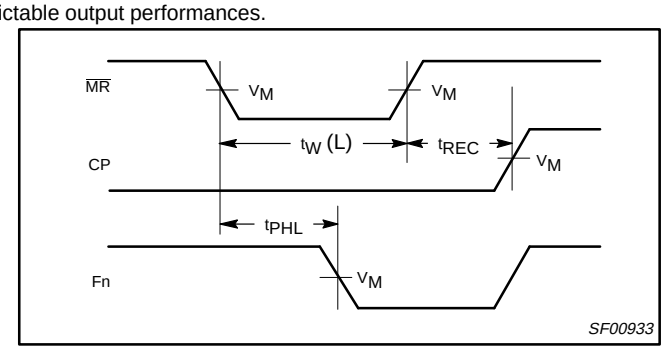
| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | $T_{amb}$ = +25°C<br>$V_{CC}$ = +5.0V<br>$C_L$ = 50pF, $R_L$ = 500Ω | | | $T_{amb}$ = 0°C to +70°C<br>$V_{CC}$ = +5.0V ± 10%<br>$C_L$ = 50pF, $R_L$ = 500Ω | | |
| | | | MIN | TYP | MAX | MIN | MAX | |
| $t_s$ (H)<br>$t_s$ (L) | Setup time, High or Low<br>An, Bn or Sn to CP | Waveform 3 | 12.0<br>12.0 | | | 12.0<br>12.0 | | ns |
| $t_h$ (H)<br>$t_h$ (L) | Hold time, High or Low<br>An, Bn or Sn to CP | Waveform 3 | 0<br>0 | | | 0<br>0 | | ns |
| $t_s$ (H)<br>$t_s$ (L) | CP Pulse width<br>High or Low | Waveform 2 | 6.0<br>6.0 | | | 6.0<br>6.0 | | ns |
| $t_w$ (L) | $\overline{MR}$ Pulse width<br>Low | Waveform 2 | 6.0 | | | 6.0 | | ns |
| $t_{REC}$ (L) | Recovery time<br>$\overline{MR}$ to $\overline{CP}$ | Waveform 2 | 8.5 | | | 9.5 | | ns |

## AC WAVEFORMS

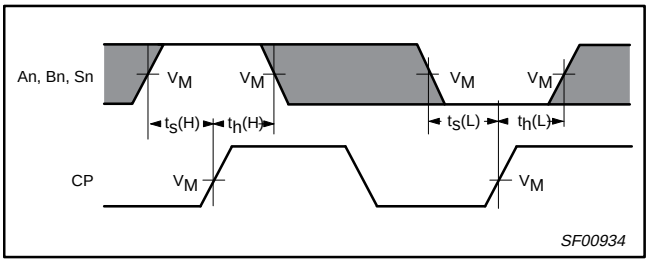
For all waveforms, $V_M$ = 1.5V.
The shaded areas indicate when the input is permitted to change for predictable output performances.




**Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width, and Maximum Clock Frequency**

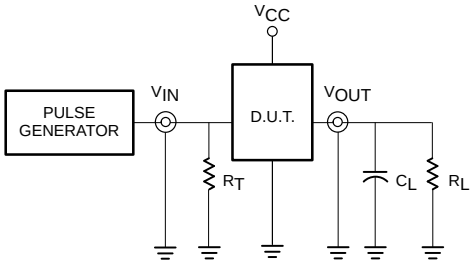



**Waveform 2. Master Reset Pulse Width, Master Reset to Output Delay and Master Reset to Clock Recovery Time**

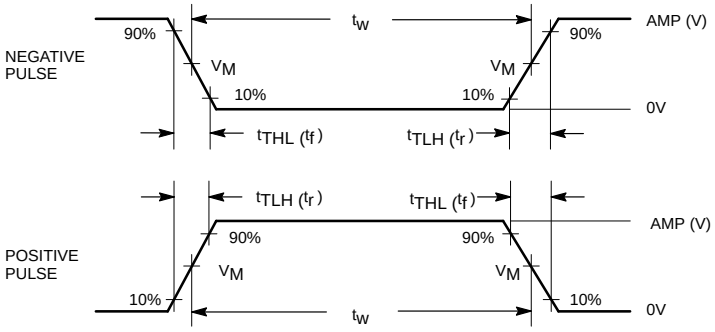



**Waveform 3. Data and Select Setup and Hold Times**

## TEST CIRCUIT AND WAVEFORM




**Test Circuit for Totem-Pole Outputs**




**DEFINITIONS:**

$R_L$ = Load resistor; see AC ELECTRICAL CHARACTERISTICS for value.

$C_L$ = Load capacitance includes jig and probe capacitance; see AC ELECTRICAL CHARACTERISTICS for value.

$R_T$ = Termination resistance should be equal to $Z_{OUT}$ of pulse generators.

**Input Pulse Definition**

| family | INPUT PULSE REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|
| | amplitude | $V_M$ | rep. rate | $t_w$ | $t_{TLH}$ | $t_{THL}$ |
| 74F | 3.0V | 1.5V | 1MHz | 500ns | 2.5ns | 2.5ns |

*SF00006*